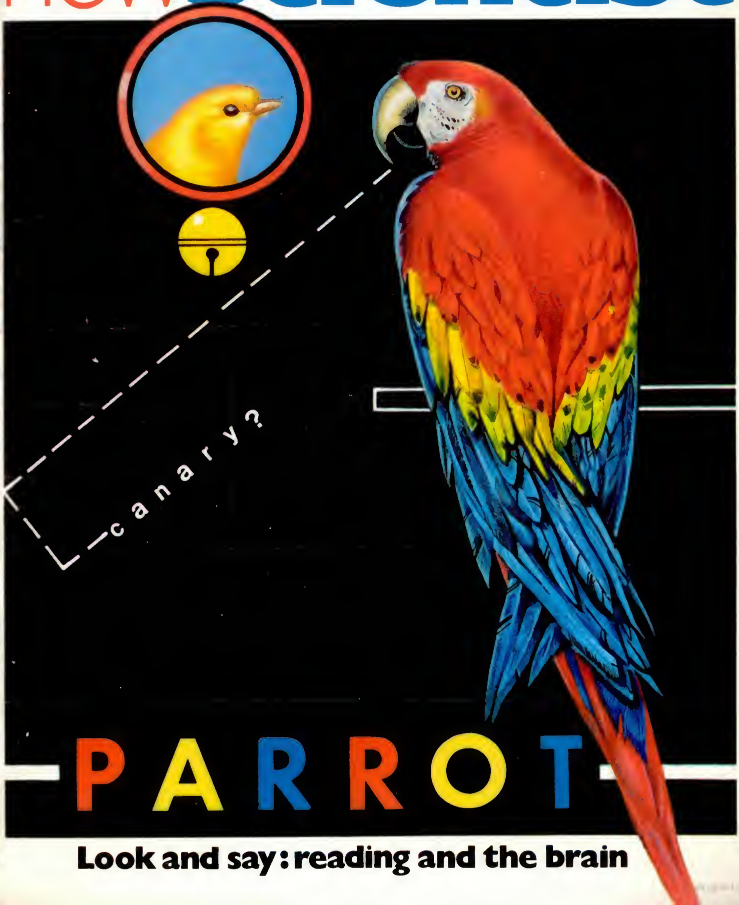
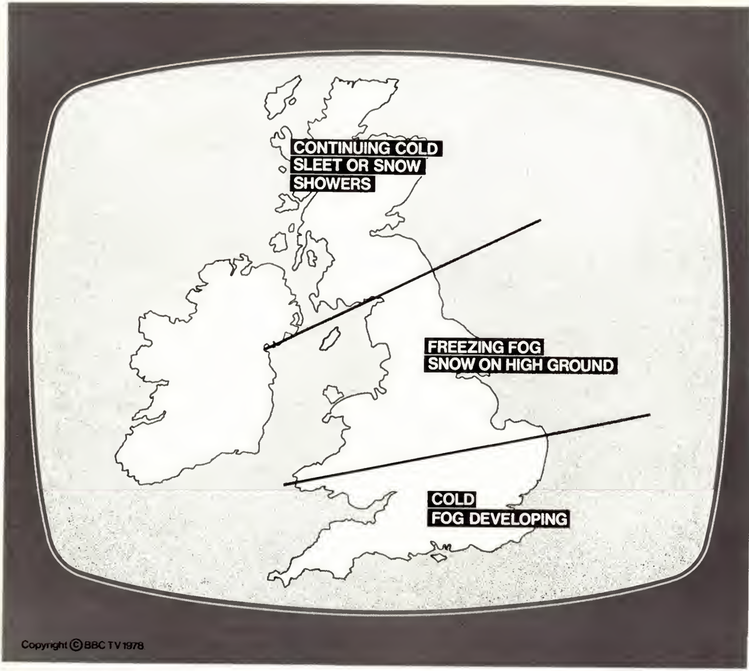
Australia 85 cents. Canada $1.00. Germany DM 3.50.
New Zealand 85 cents. U.S.A. (by air) $1.50. Malaysia $2.00 ISSN 0028-6664

8 February 1979 Vol 81 No 1141 Weekly 35p

newscientist



Look and say: reading and the brain



Just the weather for a trip by train.

When the Weather Forecast looks like this, you know what can happen. Chaos on the motorways, delays at airports. If you've *got* to be somewhere, whatever the weather, there's only one way to go. Inter-City.

And not only because it'll get you there. But because of the way it gets you there.

Quickly. In comfort. With room to stretch your legs when you feel like it. The space and relaxed atmosphere to prepare for the day's business – or even get half of it done before you arrive. And often the opportunity for a meal or a drink as you go.

So if you have to be miles away for a meeting when you'd rather not go out at all, just travel Inter-City. And relax.

Inter-City

Have a good trip!

newscientist

Vol 81 No 1141 8 February 1979

King's Reach Tower
Stamford Street, London SE1 9LS
Subscription Inquiries: 0444 59188
Editorial: 01-261 6050
News: 01-261 6142
Features: 01-261 6379
Cables: Verditure SE1
Telex: 915748 MAGDIV G

Editor
Dr Bernard Dixon
Managing Editor
Richard Fifield
Deputy Editor (News)
Michael Kenward
Deputy Editor (Features)
Dr Roger Lewin
Technology Editor
John Stansell
Biological Sciences Editor
Dr Jeremy Cherfas
Physical Sciences Editor
Dr Christine Sutton
Assistant News Editor
Stephanie Yanchinski
Science News Editor
Ros Herman
Technology News Editor
Peter Marsh
Health and Safety Editor
Lawrence McGinty
Art Editor
Chris Jones
Assistant Art Editor
Andrew Chappin
Production Assistant
Jackie Wilson
Artists
Neil Hyslop, Michael Peyton
US Office
Dee Knapp
205 East 42nd Street,
New York, NY 10017
Consultants
Environment and development
Jon Tinker
Developmental biology
Dr Brigid Hogan
Biochemistry **Education**
Dr Robert Freedman John Delln
Aerospace **Marine**
Mark Hewish Tony Loftas
Psychology **Solid state**
Dr Nick Humphrey Dr Dick Taylor
Audio/video **Computing**
Adrian Hope Guy Kewney
Physics
Dr John Gribbin
Chemistry
Dr Gordon Wilkinson
Soviet science
Dr Sarah White
Chinese science
Dr Christine King

Advisory Panel
Sir Monty Finniston FRS
Dr Basil Mason FRS
Professor Sir Michael Swann FRS

Advertisement Manager
Steven Goldsmith 01-261 5657
Advertisement Production
Tim Hartney 01-261 5951
Classified Advertisements
01-261 5731

Why is it that some people, when asked to read the word PARROT, say "CANARY"?
On p 368 Professor Max Coltheart describes deep dyslexia, and emphasises that a study of this disability may provide valuable information about reading in the unafflicted brain.

Cover by: Lawrence Mynott

362 Comment
Dr Donald Gould on parental iniquities/Ros Herman on New and Old World physicists

363 This week
Ariane boosts Europe's space research/Gay testing of liver vaccine
Canada's latest satellite/Swiss referendum on energy

368 Mysteries of reading in brain defects Professor Max Coltheart
Dyslexia lures psychologists astray

371 Dowsing achieves new credence Tom Williamson
An ancient art gets Soviet scientific backing

374 The violence of psychosurgery David Patterson
Two American neurosurgeons on trial for malpractice

376 Proteins have export problems too Dr Robert Freedman
A system of tickets helps cells to distribute their products

379 Physics in New York
Ros Herman reports on the 1979 APS/AAPT meeting

382 Monitor
New test for Einstein/Jackal helpers/Coloured cations in oleum

384 Technology
Plastic drinks bottles hit Britain/Microprocessors get larger

387 Is the Earth getting bigger? Dr Robert Muir Wood
A geologist argues that we are on a swelling planet

388 One standard lifespan Professor Stephen Jay Gould
Shrew to elephant, it is all the same

390 They can control the Sun in Cardiff Bill Gillett
Welsh throw new light on solar panels

391 Venus questions answered Eric Burgess
NASA probes beneath the planet's veils

394 Review

398 Forum
With Dr Donald Gould, Colin Tudge, Jane Moore,
Dr John Gribbin, Tim Robinson and Tam Dalyell MP

402 Feedback

403 Letters

403 Grimbledon Down

404 Puzzle

556 Ariadne

This One
655F-XHW-U0B2

PUBLISHED WEEKLY Publisher's subscription rate, Inland: £20·70. Overseas surface mail: £22·90 (Not applicable to US and Canada). US and Canada (airfreight) $54. Airmail (anywhere), £40·90. **Back numbers** (cash with order) 60p including postage from Post Sales Dept, IPC Magazines Ltd, Lavington House, Lavington St, London SE1 0PF (see last page of Classified for full details). Registered at The Post Office as a newspaper and printed in England. 2nd class postage paid at Jamaica NY 11431. Airfreight and mailing in the USA by Publications Expediting Inc., 200 Meacham Avenue, Elmont, NY 11003. © IPC Magazines, 1979.

OVERSEAS ADVERTISEMENTS REPRESENTATIVES USA. **East Coast and West Coast**, Bill Strube & Mike Coughlin, Media Force International/Strube Coughlin Associates, The Chanin Building/Suite 1121, 380 Lexington Avenue, New York, NY 10017. Tel: 212 867-2150. Telex 425442. **Mid West**, William V. Strube, The Esco Bldg, 5164 W. 95th St, Oaklawn, Ill. 60453. Tel: 312-599-7773.

CANADA Clement Dick, Chimney Copse RR No 1, Churchill, Ontario, Canada. Tel: (705) 456-2341. JAPAN International Media Representatives Ltd, I Shiba Kotohiracho, Minatoku, Tokyo, Japan. Tel: 502-0656. Telex: 22633. EUROPE Advertisement Department, New Science Publications, King's Reach Tower, Stamford Street, London, SE1 9LS. Tel: 01-261 5000. Telex: 915748 MAGDIV LDN. Cables: Verditure New Scient SE1.

Comment

Suffer little children

Four bizarre cases of severe malnutrition in British infants were described in last week's *British Medical Journal* (1979, vol 1, p 296) by doctors at St George's Hospital, and the Hospital for Sick Children, Great Ormond St, London. The babies were grossly under-weight, and showed other signs and symptoms of having been fed wholly inadequate diets. Their condition mimicked that found among small children in Third World countries where poverty and ignorance lead to the young being given food prepared largely from grains and roots, and lacking a sufficiency of minerals, vitamins and protein.

However, the British cases of such typically "tropical" infantile disease were not the result of neglect or poverty. They occurred because parents were committed to various irrational diets. They believed in the virtues of Vegan and macrobiotic foods. People who hold such views practise their beliefs with religious fervour. They stick by the very letter of the lifestyle they have accepted as an expression of divine truth. They are deaf to reason.

The babies described in the *BMJ* all recovered rapidly once they were taken into hospital and fed with the materials their bodies lacked. But the clear benefits they were deriving from their "three square meals a day" totally failed to impress their parents, who objected strongly to any violation of their beliefs. In the case of three of the starvlings, court orders had to be obtained before essential treatment could be given.

This parallels the rather commoner occasions on which a child of Jehovah's witnesses has to be made a ward of court before a life-saving blood transfusion can be given. It also echoes the state of children whose health is put at risk by parents who, for whatever reasons, refuse preventive inoculations. Last summer a disastrous outbreak of poliomyelitis occurred in a small town in Holland, populated by people with extreme religious beliefs, including an objection to immunisation (*New Scientist*, vol 78, p 890).

The authors of the *BMJ* article suggested that malnutrition of the strange kind they described should be regarded as a form of child abuse, so making the responsible parents subject to the criminal law. This seems misguided. A vast range of conditions and circumstances imposed upon dependent children by their parents might be regarded by authority, or by various "experts", as detrimental to child health and welfare. But fashions change. A practice deplored by one generation may be applauded by the next. It would seem best to rely on the instruments available already, whereby minors clearly suffering unduly from parental neglect can be put into better hands.

The best safeguards against avoidable suffering among the young is for doctors, social workers, school teachers, policemen, clergymen, and everybody else concerned with the common weal, to be aware of dangers which exist, and to know what can be done about them. *Donald Gould*

New and Old World physicists

Ever since the rush towards the atomic bomb at Los Alamos during the Second World War, the centre of gravity of physics has lain firmly within the North American continent. But today the Europeans have nothing to be ashamed of in the contribution they make to physics. The European Organisation for Nuclear Research (CERN), Britain's Rutherford Laboratory, the Max Planck Institutes in Germany, the Centres Nationales pour Recherches Scientifiques and Etudes Spatiales, the European Southern Observatory, the radio telescopes at Jodrell Bank and Cambridge—not to mention innumerable individual university groups—form a vital network.

Yet there is no real communal organisation to handle the problems of a profession under threat from many directions, or even to present a reasonably coherent picture to the outside world. At the European Physical Society (EPS) meeting last September in (old) York, the fourth of the large meetings the EPS holds every three years and the first in the UK, there was an obvious lack of a sense of community, although some of the sessions did reflect the beginning of communal concern with wider issues such as physics in the Third World, and the arms race. But it was held in an out of the way place, and had no important announcements to make to the outside world. It judged itself as an event which nobody else needed to take very much notice of.

It is really expecting rather a lot of a community of thousands of headstrong individualists, as physicists often are, who anyway feel the greatest loyalty to the international group working in their own specialism, to come to a corporate decision, or attitude, on any issue at all. Yet the American physicists who met in New York last week (see p 379) do seem to be nearer to taking enough decisions to make more effective use of their continental organisation and its meetings. This showed itself in a number of ways. First, physicists could find there facilities that are not available anywhere else: a placement service for those seeking first or new jobs and a workshop session to give them some idea of how to go about it, as well as a special afternoon session on physicists using their skills in unusual settings—economics, computers, market research and medical science. There was a special programme for teachers, and one for students. Participants could attend a session on the Einstein centennial, and find out from last year's winners how to win a Nobel prize.

Then there were sessions designed to make physicists more aware of important issues that affect their own community—for example, a meeting on women in physics: why aren't there more? A very worthwhile choice—and a brave one—was the session on physics and parapsychology. This attracted much interest and controversy: the discussion had still not ended at ten thirty in the evening, three hours after it began. Faced with a researcher who believed he had demonstrated the reality of psychokinesis, a sceptic who acknowledged the effect but didn't accept the explanation, and a chairman who was keen enough to settle the issue to put his name behind a call for outside testing, the physicists gave free rein to all the ideas they had stored up on reading books, newspaper items, and chatting as ordinary social animals.

Another boost to the meeting was the publication in the middle of it of a report commissioned from the American Physical Society by the US Department of Energy. Whether by accident or design, this brought many journalists into the meeting, and after the press conference they browsed at lunch over papers describing some of the meeting's sessions and talked to the organisers. They could not help but realise that there were a lot of people around talking about exciting and important subjects.

Peharps the more monastic European physicists are right; scientists have never worried too much about what other people think of them, so why should they start now? But as the research community ages without replenishment and one by one specialisms are totally taken over by the Americans and many of the best researchers cross the Atlantic, let them not complain that "the community" has had a raw deal. There isn't one to speak of. *Ros Herman*

This week

Europe thrusts ahead in space

Michael Kenward, Kourou, French Guiana

The dream of European independence in satellite launching came nearer to reality this week. On Monday a complete Ariane launcher stood alone on the Kourou launch pad for the first time, and yesterday the French Guiana Space Centre at Kourou was due to fire a sounding rocket to test the ground facilities that have been set up for the Ariane launch programme.

As Ariane approaches its first launch or LO1, this year—now set for November (*New Scientist*, 25 January, p 236)—the European Space Agency (ESA) is beginning to plan for the future of its launcher programme. On Monday ESA director Roy Gibson told a party of journalists invited to watch the first "roll out" of Ariane that within the next two or three months he would like the participants in the programme—France dominates the field with a two-thirds share of the project—to approve construction of the second production batch of five launchers. At the same time he described the Ariane improvement programme put forward by the French Space Agency, Centre Nationale D'Etudes Spatiales (CNES).

The second set of launchers has to be ordered very soon if ESA is to send four rockets a year into space—this is as many as the Kourou centre can handle with the present facilities. The agency already has customers for the first five operational launchers—this series is due to start early in 1981. These production launchers will carry aloft: Exosat, an ESA scientific satellite; the first of a series of European communications satellites, ECS 1; the European maritime communications satellite, Marecs B (this used to be called Marots but ESA changed its name to confirm its rise in status from a test satellite to an operational satellite), along with a second satellite, Sirio 2, giving Ariane its first chance to launch two satellites into geostationary orbit; an Intelsat telecommunications satellite, and the French SPOT satellite for Earth observations.

With four ECS's planned—ESA's council approved Ariane's launch of numbers 2 to 4 at a meeting last December—one more ESA scientific satellite confirmed, and more under discussion, not to mention the possibility of more Meteosat weather satellites. Roy Gibson believes the time has come to order five more Ariane launchers. But governments may feel it is premature to order more production rockets before the first proving launch—to build and launch five more Arianes will cost between $200 and $250 million.

Gibson believes that the Ariane programme has gone very smoothly and he foresees none of the problems that caused the cancellation of the ill-fated Europa programme. If something does go wrong with LO1 ESA will have spent very little on the next production batch. In all ESA estimates that there could be a market for 40 to 50 Ariane launch vehicles over the next 10 years and at the moment the agency is competing successfully with NASA's Space Shuttle.

Ariane's competitiveness will certainly improve if the upgrading programme is approved. CNES has put forward several options. One is a study to see how production costs can be cut. There is also a proposal to see if it makes sense to recover and reuse Ariane's first stage—which accounts for nearly half the cost of each launcher.

ESA's most likely improvement for Ariane would be a straightforward increase in its payload. The CNES proposal would allow Ariane to put 2300 kg into a parking orbit from which it could be boosted into a geostationary orbit—an increase of 600 kg on its current capacity. Such an increase would allow the launch of, for example, two Intelsat telecommunications satellites on a single Ariane launcher. An improvement of this order would increase Ariane's competitiveness significantly. The improved Ariane, which could be available by 1983 will cost only a few per cent more than the basic launcher. □

US accelerates Chinese science development

President Carter and the Chinese Deputy Prime Minister Teng Hsiao-ping have signed a wide-ranging science and technology agreement to cement the rapidly growing academic and technical contacts between their two countries. It includes a number of understandings reached in the past two months about educational exchanges, space and agriculture, but these are not all.

The most important new accord is in high energy physics. The US will help the Chinese design and build a 50 billion electron volt (GeV) proton synchrotron accelerator in Peking. It will be similar to the 30 GeV alternating proton synchrotron at the Brookhaven National Laboratory, and is likely to cost China between $100 and $200 million over the next five years. Dr John Deutch, director of energy research at the US Department of Energy, calls high energy physics a natural area for US-Chinese cooperation—not only is it "a very international business" but also one in which many Americans of Chinese descent have made distinguished contributions.

More details have also emerged of the space technology agreement concluded in December. The US will sell China a satellite communications system, including ground stations, for about $500 million. The Chinese will use it to broadcast colour television, improve their telephone network, and set up a national satellite educational system, to try to overcome an acute shortage of teachers. In addition the US will build a ground station in China to receive remote sensing information from the Landsat satellites.

"... And if the SALT talks fail they'll train a million men to break armour with their bare hands."

Educational exchanges between the two countries have already begun. A hundred Chinese "students", actually experienced scientists in their 30s and early 40s, recently arrived for advanced training at major American universities. By the end of 1979 500 Chinese should be studying in the US. The first 12 American scholars are scheduled to travel to China within the next two months, and another 50 will follow in September.

Shortly before Mr Teng and Mr Carter signed their agreements in front of television cameras in the White House last week, American newspapers reported that China had refused entry to two of the first party of American scholars, scheduled to begin research there this spring. But Dr Frank Press, President Carter's science adviser, said later that the administration felt "reasonably sure" that the two social scientists would be admitted to China to study such things as the welfare of the elderly and social changes among peasants. Dr Press said the Chinese had given assurances that they would not bar any American researchers for political reasons. He asked reporters to remember that the Chinese had real difficulties finding suitable accommodation for Western scholars after the recent turmoil. □

Gay start to liver vaccine trial

The Americans have entered the first stages of testing for efficacy a vaccine against one type of hepatitis. Earlier studies done over the past two years have shown that the vaccine is safe and can induce satisfactory levels of protective antibody. The first group of volunteers—homosexual men—have already received their initial shots of the vaccine and before the end of this year close to 10 000 persons will have been enlisted in the trials. Details were summarised at a workshop on hepatitis vaccines held by the US Food and Drug Administration.

The vaccine is intended to protect against hepatitis type B. It will not be effective against type A hepatitis, the other known type of liver disease, or hepatitis that is caused by other, as yet unidentified viruses. Nevertheless, hepatitis B is not only a serious disease clinically but also a major public health problem throughout the world. At least 60 000 cases of hepatitis B are reported annually in the US and this is thought to be only about 10 to 20 per cent of the total. Elsewhere in the world, it is estimated that at any one time there are probably around one hundred million or more infected individuals capable of transmitting the disease. In many instances they are actually ill.

The trials are being done in a randomised, double-blind manner and, allowing for dropouts over the projected two-and-a-half year trial period, are expected to provide final efficacy data on around 4000 individuals. The prolonged period needed to determine efficacy is a reflection of the long incubation period of the disease.

Because it has not been possible to cultivate the virus in the laboratory the vaccine is prepared from human blood donors who have high levels of hepatitis B virus in their circulation, but who are otherwise healthy, that is they do not have symptoms of hepatitis. The final dose level at which the vaccine will be used generally, assuming it receives approval from the government, has still to be worked out. However, at the moment the trials are using two shots one month apart containing 40 micrograms of virus. A booster shot is given at six months.

The exceptional high risk of such groups acquiring hepatitis is the reason why volunteers are being selected from three special groups of the population. The risk of hepatitis among chronic dialysis patients is anywhere from 50 to 85 per cent. Gay men are, if anything, at even higher risk. Although the risk of hepatitis is lower among dialysis unit staff members—about 30 to 50 per cent—this is still regarded as high enough to obtain reliable evidence of efficacy. Gay men are particularly good subjects for studying the efficacy of any vaccine against hepatitis. For the most part they are well educated, recognise the problem they have with the disease, and are highly cooperative. ☐

Science in a Benn context

Britain's Energy Secretary Tony Benn gave the newly formed Science, Technology and Society Association a rousing start at the weekend. Benn, addressing the society's inaugural meeting at North East London Polytechnic, pointed out the problems of ensuring that decisions concerning science and technology were democratic ones. He said concentrations of expertise—in the military area for example—could sometimes sway policy decisions without proper discussion of all the issues.

Benn cited as examples occasions when, in his own ministry, he had not been told of important developments concerning nuclear energy. He said one way of democratising science was to make government as open as possible with more dissemination of information.

The new association, of which Benn has agreed to be president, is the successor of another similar organisation—Science in a Social Context (SISCON). That group is due to wind up later this year because the grant that has financed it for the past five years has run out.

Tony Hargreaves, a committee member of the new association, said this week the aim was to further the work of SISCON but to broaden its scope. SISCON has been mainly an academic group examining the impact of science on society. But the new organisation will aim for a wider membership, including trade unionists for example. The plan is to arrange conferences, seminars and an annual summer school. Membership costs £5 and further details can be obtained from the association's secretary, Gordon Lake of Newcastle Polytechnic's Department of Humanities. ☐

Post Office blamed for electronics lethargy

Most countries have problems over "technology transfer"—the way in which an idea conceived on the work bench turns into an innovative, useful product. But Britain's problems, according to a conference last week in London, are made worse by the inflexibility of one of the country's biggest businesses—the Post Office. The point at issue is over what may be attached to the end of a telephone line. The Post Office has sweeping powers defining exactly what type of attachments are permitted. And this, according to several speakers at the conference on the future of telecommunications, gravely inhibits UK manufacturers' efforts to keep up with the rest of the world.

Behind this serious allegation is the Post Office's statutory monopoly over most forms of message communications. It imposes strict guidelines over what may—and may not—be connected to its telecommunications system. These rules apply to the ordinary telephone handset. This is why many types of "exotic" handsets, for instance those with computer stores which can "remember" numbers, are banned in Britain. The rules apply equally to the sophisticated computer terminals, bristling with microelectronic devices, that manufacturers are making today to tag on to the end of the phone system. This practice is part of the much discussed "convergence" of telecommunications and computers.

Frederic Lamond, a telecommunications consultant, told the conference that the Post Office had failed to respond to the challenge of the micro-electronic age. By mounting tight control over attachments, the Post Office drastically restricts business users' choice of terminal equipment. And this is a crucial handicap to UK manufacturers' drive to make better and cleverer terminal hardware.

Lamond cited as an example the development by one of Britain's largest electronic firms, GEC, of a certain type of computer-controlled private exchange. The exchange was acknowledged to be extremely "intelligent"—that is to have a lot of processing power. But GEC had to develop the product—not to improve it, but to make it less "clever" to fit in with the Post Office's requirements.

Lamond said the only way forward was for the Post Office to give up its monopoly over attachments. The range of terminals that the Post Office permits today would then compete freely with all the other products available. In essence, this would put the Post Office in line with other nationalised utilities such as the gas and electricity boards. The corporation's chosen hardware would still get a large share of the market, and its employees would still find work in maintaining it. But this would not exclude manufacturers from forcing their way into the market, purely on the grounds that consumers preferred their products.

The Post Office has always defended its monopoly on attachments on the grounds that a relaxation would lead to a practice it calls "cream skimming". Manufacturers could get the orders for terminals in accessible places like London, while the Post Office, because of its statutory duties, still had to supply out-of-the-way areas like the Outer Hebrides. In this way, denied the "cream" of the business, the Post Office would be left with the milk—and rapidly lose money.

But another strong reason for the monopoly remaining is the attitude of the Post Office Engineering Union. Ted Webb, a POEU official, told the conference that the monopoly was "in the best interests of the country." But he also said it was needed to help safeguard his members' jobs. The POEU's view is that job security is rather easier to guarantee if only POEU workers are permitted to maintain terminal equipment—something that would no longer apply if the monopoly was scrapped. ☐

Canadian frontiers open up to new satellite

Canada's Anik-B super-communications satellite was launched in December by the National Aeronautics and Space Administration, under the watchful eye of a new, potential customer, the People's Republic of China. A Delta 3914 rocket, equipped with a new, self-correcting, inertial guidance system for the first time, lifted the one-ton "comsat" toward geostationary orbit before a rain-dampened throng of enthusiastic Canadians, taciturn Chinese technicians and 35 astronaut trainees, some of whom were seeing their first launch. The Chinese came to inspect launch facilities. China is negotiating purchase of a communications satellite system, to be orbited in 1980 by the Shuttle.

The Canadian contingent, led by Jeanne Sauve, the country's Minister of Communications, also looked at Shuttle launch preparations. But Minister Sauve told an interviewer frankly that she is considering the European Space Agency's "Ariane" rocket as a launcher for future Canadian space payloads as well as the Shuttle system. It will be a matter of price, she said.

Built by RCA-Astro-Electronics for Telesat of Canada, Anik-B is touted as the most powerful communications satellite intended for domestic use. Anik is an Eskimo word for brother. It has 12 channels in the 6-4 gigahertz (GHz) band and six in the more powerful 14-12 GHz band. From a geosynchronous altitude of 22 300 miles over the equator at 109 degrees west longitude (the meridian of western Saskatchewan), the satellite's beam can reach all of Canada coast to coast, from the US border to such Arctic outposts as Resolute on Cornwallis Island. Resolute is about 210 miles east of the magnetic north pole at 75 degrees north latitude. Beyond it, the polar curvature of the Earth limits the range of the satellite.

Telesat, the semi-public corporation which operates Canada's communications satellite system, paid $20 million for the satellite and $20 million to NASA for the launch. Anik-B will replace two older, Anik-A satellites launched in 1972 and 1973. A third Anik-A in the lower frequency band series will be relegated to a back-up role after three years in service.

The second largest country in the world, with vast areas thinly populated, Canada has leap-frogged over land lines and microwave relays into communications satellite links to tie together its thousands of remote communities. In the past, many were dependent on radio which was often interrupted or blacked out by the ionospheric disturbances of high latitudes, especially when the Sun was active. Stringing land lines to remote towns, villages, settlements and mining camps was economically out of the question. The Anik satellite system, started in 1972, has filled these white spaces on the map with voice and television communication.

With its high frequency band, Anik-B can reach specific targets, even in urban areas, without danger of interference. Receiving antennas can be smaller and cheaper than those required for the earlier satellites. The Canadian Department of Communications has leased four high frequency channels to test 14 educational and social service programmes, to be beamed at both professional organisations in the cities and to remote areas. All the other channels will be leased by Telesat to the Canadian Broadcasting Corporation and to telephone companies.

The implementation of some of the proposals to use Anik-B means that Canada will evolve one of the most ambitious satellite social service and educational programmes to date. For example, educational programmes covering such subjects as gun control, English as a second language and health are to be extended via the satellite to Eskimo communities in the far north. □

RCA

By the 1980s Anik-B will link 25 educational institutions in British Columbia with remote villages in the Yukon

Satellite communications reach for the sky

Revenues from commercial satellites throughout the world will rocket from $420 million at the end of last year to over $1 billion by 1983, according to US market research consultants Creative Strategies International in *Satellite Communications.* This growth rate of 19 per cent per year is only one of a number of startling forecasts made by CSI for this relatively young industry.

Among the others are that sales of satellites alone will total $1·5 billion over the next five years and growth in demand for small, Earth stations will still be rising in 1983, despite sales reaching $217 million by then. CSI also highlights the coming battle between computer giant IBM and the huge US telecommunications company American Telephone and Telegraph (AT&T), and the effects that satellite communications will have on both business methods and home entertainment.

CSI's report divides the market into three sections, of which the largest is communications services. Of the predicted revenue of $1·02 billion in 1983, CSI calculates that $722 million will come from operations outside the US and approaching half that—$301 million—from US communications markets alone. The other two market sectors cover hardware, for satellites themselves and for small Earth stations.

The report does emphasise that the market has its disadvantages and limits. It is an expensive one to get into and CSI estimates that participants will have invested, or lost in operational costs, over $1 billion by 1983. Orbital space constraints will limit the number of satellites that the US can put up to 16, of which six are described as prime "slots". The report forecasts that the most bitter and hard fought battles will be before the Federal Communications Commission, which allocates parking slots.

Dominating the competition over the market will be the efforts of IBM and AT&T to protect their major sources of revenue, as the two areas, large computers and telecommunications networks, converge. CSI describes how IBM has already made its mark here through its ownership of Satellite Business Services (SBS)—jointly with COMSAT General and a Connecticut-based insurance company. SBS will link large scale data centres to remote users with systems handling ordinary voice traffic as well as data, thereby providing a practicable alternative to AT&T. SBS will also offer new services such as low cost teleconferencing, at a cost less than is now charged for a simple phone call between two people.

AT&T's only remaining hope of protecting traditional markets is to "fight it out in the market". It will both launch its own satellites and offer a range of new services to "meet IBM head on".

The CSI report also outlines the developments in technology that will change the nature and scope of satellite communications. For example, launchers such as the Shuttle and Ariane will cut launch costs by as much as 70 per cent, CSI predicts. This will reduce the investment in a communications satellite from the $32 500 per circuit of the first Intelsat launched in 1965 to about $800, so increasing demand for long distance links and making it economic to use satellite communications over short distances.

New developments in microelectronics will cut payload weights and power requirements while the heavy, power hungry and unreliable travelling wave tubes (TWTs) that generate radio-frequency power in today's satellites will be replaced by solid-state devices. At present field effect transistors (FETs) appear to offer the best hope for replacing TWTs. □

Copyrighted material

Swiss prepare for nuclear referendums

David Dangelmayer Basle

Can nuclear energy survive in a properly functioning democracy? The Swiss, in their thorough way, will provide one answer on 18 February, when the nation votes in a federal referendum on whether to introduce tough new licensing criteria for nuclear installations. Adoption of the proposals, which would take the form of an amendment to the constitution, would effectively impose a moratorium on the construction of new nuclear power stations, and could eventually lead to the shutdown of existing ones.

Much more is at stake than in neighbouring Austria's nuclear referendum last November, when the electorate narrowly rejected its government's atomic energy policy and voted to close down the country's single nuclear plant, the 700 MW unit at Zwentendorf. Switzerland's nuclear programme is one of the most concentrated in the world, and the confederation is home to several leading nuclear energy concerns led by BBC (Brown Boveri). Roughly one-fifth of Switzerland's electricity production stems from the three nuclear plants already in operation (Beznau I and II, and Muehleberg); the figure will rise to around one-third this summer when the newly completed 920 MW plant at Goesgen goes fully on stream.

The referendum proposals centre on what the sponsors, an action committee which has been campaigning for years to bring the issue to the people, call "a licensing procedure which takes full account of the opinion of the population". In 1975/76 the committee collected around 125 000 signatures to hand to the government in order to secure the referendum.

The proposals envisage that parliament would be responsible for awarding 25-year concessions for operation of nuclear plants. Utilities would have to comply with strict safety and environmental conditions (as they do already), but these would include the key new criterion of full provision for long-term disposal of nuclear waste. The concession would be granted only if it were approved in a series of regional referenda, not only by the electorates in local communes but also by those in every canton within 30 kilometres of the site.

The government and nuclear industry are convinced that strong local opposition to the presently proposed new plants, most of which are in the Basle region in north-west Switzerland, is so powerful that none would ever be approved under this system—especially as individual cantons would have what amounts to a veto right. Equally distressing to the nuclear planners is the proposal that a new concessionary formula should apply to existing plants. Unless these fulfilled additional safeguards within three years (a period judged as only a relatively short time to comply with the extra bureaucracy), they would be shut down.

The government has urged the electorate to reject the proposals. Officials in Berne are reasonably optimistic that they will, but, pointing to the emotional nature of the campaign, concede the possibility of a surprise defeat for nuclear power along Austrian lines.

The consequences of an anti-nuclear vote would certainly be disastrous for the country's energy policy. Switzerland has no gas, oil or coal reserves of its own, and its ample hydroelectric resources have been enlarged over the years to very near maximum capacity. The government is relying on the addition of some 4000 MW of nuclear capacity by the year 2000 to meet what it projects will be an 80 per cent rise in electricity demand over that time. To go some way toward the demands of the nuclear protesters, the government is proposing sweeping revisions to the 1959 Atomic Energy Act to tighten up the permit system, raise the utilities' liability for nuclear accidents, and possibly to take over itself the responsibility for radioactive waste disposal.

Switzerland's Goesgen reactor centre

This latter issue is perhaps the key question of the Swiss nuclear debate. The present arrangement is for spent fuel elements to be sent for reprocessing to the Cogema plant at La Hague, France: Switzerland has no responsibility eventually to take back and dispose of the final waste. But government officials forecast that under future reprocessing contracts the utilities will have to accept "take-back" provisions. The crucial period, when sites for final storage of high-level radioactive waste must be in operation, will start around 1990.

The utilities are making preliminary soundings about burying waste in underground anhydrite deposits at five possible Swiss sites, but in each case local opposition is strong. Certainly under the proposed regional approval procedure (which would cover storage sites as well as basic nuclear power plants), such facilities could never be established in Switzerland.

The nuclear industry would prefer to consign the high-level waste abroad, and points to the international leaning (at the initiative of the US) toward centralised long-term waste storage at well-controlled international plants. But as long as doubts remain over the operation of such plants as the controversial centre at Gorleben in north-east Germany, whether or not this strategy will succeed is far from clear.

As far as the safety aspects of the nuclear plants themselves are concerned, the nuclear industry is making great play of the unique "alarm system" which has been installed at Goesgen. About 15 000 households within some 5 kilometres of the plant, which is close to the village of Daeniken south of Basle, have been issued with a 19-page instruction booklet, produced by the local council and federal authorities. This tells local people what to do if radioactivity escapes from the plant. The central piece of advice seems to be that the locals should go to their cellars when the danger signal sounds over the station's high-powered sirens, and stay there until the all-clear is given.

As well as pointing to these elaborate safety precautions, in the closing weeks of the campaign the government has appealed to voters with long enough memories to reflect on how they gave a resounding "yes" to atomic energy when the first referendum on the subject was held in 1957. "It was all atomic euphoria then," one government official recalls.

For its part, the action committee—which can claim support from a broad spread of political and scientific opinion—is launching its case in a series of multicoloured campaign brochures. The alternatives are spelled out: better insulation; fewer oil-fired heating systems in the home; less energy waste; more investment in "alternative" energy, such as solar installations high up in the Alps; and a trimming of Switzerland's sizeable electricity exports.

Even if the committee's proposals are defeated, that will not be the end of the matter. Because another group last month managed to amass enough signatures protesting against the proposed revision of the Atomic Energy Act, a separate referendum will be held on this issue in May provided that the subject has not been settled once and for all on 18 February by the Swiss voters. ☐

Baby chimp sends human signs

Washoe, the first chimpanzee to use American Sign Language (Ameslan), has given birth to a son, Sequoyah, who is one month old today (Thursday). Roger Fouts, who has been tutoring the famous chimp for many years now at the University of Oklahoma, reckons that the infant will pick up Ameslan from his mother: "Sequoyah will probably give his first sign between four and 12 months," he says.

Although chimps in the several primate language centres around the US do sign to each other, so far none has passed on its "alien" form of communication to another. There is a good chance that this will happen between mother and son.

Washoe has been a passable mother in all things, apart from suckling. Her contact with humans seems to have distracted her from this important task. Fouts says that if he fails to encourage Washoe to suckle properly, he will try to teach her to bottle feed Sequoyah. Meanwhile, everyone will be watching out for the infant's first word—sorry, sign.

This isn't the first time Washoe has given birth. Just over two years ago she produced an infant that died shortly after birth, a tragic event that revealed chimpanzee emotions in a dramatic way: squatting near the corpse, Washoe repeatedly signed "baby, baby," as if she was urging her infant to respond normally, or perhaps it was simply a cry of simian grief. ☐

Quick test for Legionnaires' disease

A new test which identifies patients heavily infected with Legionnaires' disease only one to seven days after the onset of illness is reported in the January issue of the *Annals of Internal Medicine*. It involves immunofluorescent staining of sputum samples and has been developed by Claire Broome at the Center for Disease Control, Atlanta, Georgia.

Despite two and a half years of intensive research, no reliable and quick method has been developed yet to diagnose Legionnaires' disease in patients with bacterial pneumonia. The antibiotic erythromycin is very effective against the disease but the blood test in use takes three weeks to yield positive results, by which time it is often too late for an effective treatment.

Broome's test developed from the discovery that immunofluorescent staining rapidly identified the disease bacterium in lung tissues. Such a test obviously could not become a routine screening procedure but sputum samples are much more accessible. Long term stored sputum smears taken from 21 patients one to seven days after the onset of the disease were tested, along with 47 controls from patients who had suffered a wide range of other bacterial lung infections. The smears were fixed with formalin and treated with Legionnaires' disease antibodies formed in rabbits and labelled with fluorescent dye.

Smears from five of the 21 diseased patients clearly contained the disease bacterium while none of the controls were positive. Unfortunately, the sputum samples sat in cold storage for months before the test was done and this may be why 16 cases of Legionnaires' disease went undetected. But only five of these negative cases eventually died, compared to four of the five giving positive results. Broome concluded the first group was less severely affected and that the test could not pick these up. However, fresh samples, treated at once, should greatly improve the test's sensitivity. By identifying heavily infected patients rapidly, it should be possible to save many lives. ☐

Stunted children receive a boost

Treatment of human dwarfism in children living in the Canadian province of Ontario is severely hampered by a shortage of the human growth hormone secreted by the pituitary glands located in the brain. But plans are going ahead to increase vastly the supply by removing pituitary glands at all future coroner-ordered autopsies in the province. The pituitaries will be processed at the University of Manitoba, the national centre for human growth hormone extraction. The hormone will then be returned to Ontario to treat dwarfism in children.

Growth hormone, which controls skeletal development and general body growth, is different for each species, unlike insulin, for example, which is extracted for human use from cattle pancreatic glands. The shortage in Ontario means only about 50 children, of an estimated 100 who need it, are currently receiving treatment for hormone-deficiency dwarfism.

Human growth hormone was first extracted at McGill University in the 1930s by James Collip, who had earlier produced therapeutic insulin for Sir Frederick Banting and Charles Best in 1922. A nationally-subsidised treatment programme for pituitary dwarfism began in Canada in 1967.

The current source of human pituitary glands is voluntary donation. Several years ago Ontario added to its driving licences a form of consent, which can be discarded by drivers at will, under the Human Tissue Gift Act. The new source of hormone, from about 9000 autopsies a year, is sanctioned by an amendment to the province's Coroners Act. But it may not supply the whole need in Ontario. It is hoped that other provinces will follow Ontario's example. ☐

Seven Days
28 January to 3 February

29 JANUARY The UK's Science Research Council announced the appointment of Dr Godfrey Stafford as director-general of the combined Appleton and Rutherford Laboratories (*New Scientist*, 25 January, 1979). Dr G. Manning will take over as director of the Rutherford during the transition period of five years. Both will assume their new duties on 1 September, 1979. Meanwhile, the council is still "actively seeking" a director for the Appleton Laboratory.

29 JANUARY The New York City Health Department has confirmed the presence of a Legionnaires' disease bacterium in a specimen taken last fall from a second cooling tower on the 11th floor of Macy's department store in New York. Although the Center for Disease Control officially announced last autumn, that investigations, following an outbreak of the disease, revealed the bacterium had been found in one of the two cooling towers, the city officials had withheld the information during the Christmas shopping season. The cause of the August outbreak in the garment centre of the city remains unknown.

1 FEBRUARY The UK's Department of Energy announced that at least £13·5 million will be available for interest-free loans for new technological developments in the exploration, production, transport and storage of hydrocarbons. The money will come from the European Commission, under the Community Projects in the Hydrocarbons Sector scheme, introduced in 1973 to improve the EEC's oil and gas supplies.

1 FEBRUARY The latest report published by the UK's National Economic Development Council's working party on electronic components concluded that the UK government should do more to discuss fears that microelectronics in industry will cause widespread unemployment. The working party called for a greater dissemination of available information about the employment effects of chips and for greater consultation over what could happen over the next ten years.

THE NEW SCIENTIST
20 years ago

The Town Planning Committee of the London County Council reported this week its proposals for a flyover bridge to carry the newly constructed Cromwell Road Extension—which will be the main trunk road out of London to the West—over existing roads at Hammersmith. The flyover replaces a very large island roundabout, and a considerable ground area will be saved by the new crossing. The importance of the proposed new flyover is, however, greater than this. It signifies the beginning of a new outlook on road constructions and shows that British engineers and planning authorities are at last beginning to think three dimensionally. Those who fear that elevated roadways and flyover crossings are unsightly can be reassured, especially by what has been done in Belgium and Germany. Improvements in the design and construction of reinforced and prestressed concrete bridges have resulted in graceful structures which, properly used, can improve the appearance of cities.

The New Scientist, 3 February, 1959.

Mysteries of reading in brain defects

Profound disorders in parts of the brain responsible for reading and speaking throw light on the way the normal brain works

Max Coltheart
is professor of psychology at Birkbeck College, London

The human brain is divided into two halves, the two cerebral hemispheres, and although these two hemispheres look rather similar, they differ in their functions. For nearly all of us, the left hemisphere of the brain contains mechanisms which are of vital importance for linguistic capabilities—reading, writing, speaking and understanding speech. Hence, damage to various parts of the left hemisphere can produce various linguistic disabilities.

Two such disabilities, recognised since the pioneering work of the French neurologist Joseph Déjérine at the turn of the century, are *alexia with agraphia* and *alexia without agraphia.* The first disorder makes it difficult or impossible for patients to read *(alexia)* and their writing is also seriously impaired *(agraphia).* Patients suffering from alexia without agraphia, on the other hand, cannot read but are able to write. For example, if asked to write a brief passage on some topic, they can do so, but then are unable to read what they have written. Déjérine was fortunate enough to have been able to carry out post-mortem investigations on both types of case, and as a result of these studies he proposed a theory of the anatomical bases of the two disorders, a theory which is still generally accepted today.

French children learn their alphabet in 1876

Studies of the two forms of alexia—with and without agraphia—have been quite sophisticated as far as neurology and anatomy are concerned, and have provided considerable information about the neuroanatomy of reading. But these studies used remarkably crude psychological techniques. The patient's ability to read was usually assessed simply by asking him to pronounce aloud single printed words, short phrases, or sentences. To the extent to which the patient is unable to do this, he is said to be unable to read. One reason why such methods are inadequate is that inability to read aloud does not imply inability to comprehend, nor the converse. Most people could read aloud the word NAM, but not many would understand what it means (Hungarian for "Yes"); I understand that means "man" in Japanese, but cannot pronounce it aloud because I do not know the Japanese for "man". Furthermore, "alexic" patients can quite often read some words and not others; it is obviously of interest to determine which kinds of words a patient can read and which he cannot, but this kind of information is rarely reported.

Our knowledge has, however, increased dramatically in the past decade, as experimental psychologists have begun to participate in tests of alexic patients. In particular, one specific form of alexia, usually called *deep dyslexia,* has been studied intensively. The syndrome is associated with left-hemisphere damage, and patients who suffer from it also exhibit difficulties in writing; but the question of whether deep dyslexia is one form of, or is actually synonymous with, alexia with agraphia, remains unanswered. This is perhaps not an important question. What is important is the syndrome of deep dyslexia itself, as so much is now known about it.

The essential symptom of deep dyslexia is the *semantic error.* The first person to describe this symptom was the English neurologist Hughlings Jackson, in 1878. He studied a patient in whom damage to the left hemisphere had produced a reading disorder. Jackson tested the patient's reading by asking him to read aloud single printed words, and reported that, when asked to read out the printed word TABLE, the patient responded "chair". Such responses have come to be called semantic errors because although the response is wrong, it is semantically related to the stimulus, so the patient must have understood at least to some extent the meaning of the word he was looking at; but if so, what prevents him from uttering the correct word?

The occurrence of semantic errors was occasionally mentioned in case studies of alexia after Jackson's paper, and eventually a few reasonably detailed studies of the reading behaviour of patients who make such errors appeared. Only since 1966, however, has there been intensive study of the syndrome. In that year, John Marshall and Freda Newcombe published a study of a deep dyslexic, G.R., which gave detailed information about how he read. Even more important, they argued that the behaviour of dyslexic patients like G.R. could provide us with insights into fundamental aspects of linguistics, and conversely that linguistics could provide an understanding of why such patients read the way they do. Their work immediately drew the attention of experimental psychologists and psycholinguists to the syndrome of deep dyslexia, and more than a dozen different cases have now been described in detail. At present, cases are being investigated in many places, including Baltimore, Oxford, Cambridge, Paris, Tokyo and East Germany.

It very soon became apparent that this syndrome exhibited a number of remarkable features. The ability of deep-dyslexic patients to read a single printed word aloud depends on the part of speech represented by the word. They read nouns best, followed by adjectives, then by verbs; worst of all are function words (articles, prepositions, conjunctions, and so on) despite the fact that many of these occur with great frequency in printed English. A patient unable to read BE could read it aloud successfully when an extra E was added to the word (converting it from a verb to a noun). A patient asked to read what is perhaps one of the commonest adjectives in English—NICE—nevertheless treated it as a much rarer noun by responding "Place in the South of France". Many other errors have been collected, some straightforward and some more convoluted. When shown the word KIEV the response was "Odessa", and to ITALY, "republic". Another place provided more of a problem; the response to HOLLAND was "It's a country . . . not Europe . . . no . . . not Germany . . . It's small . . . it was captured . . . Belgium. That's it, Belgium!" Triumphant, and almost correct. Function words are particularly difficult; patients may correctly utter fewer than a third of the words from a list of very common functions words (AND, THE, A, UP, BY, FOR, TO, OR, ON and so on). The probability that a deep dyslexic will be able to read a word aloud is also powerfully affected by how abstract the word is. Abstract words (for example, ORIGIN, CUSTOM, FILE, or CHARM) are read far less well than words which are concrete (for example, SOLDIER, CUSTARD, FACE or STORM).

Semantic errors are not the only kinds of errors made by the deep dyslexic. Often his attempt at pronunciation produced a "visual error"—a response which resembled the stimulus visually rather than semantically (responding "sandals" to SCANDAL). Karalyn Patterson, at the Applied Psychology Unit at Cambridge, discovered that visual and semantic errors differ in an important way. When a patient makes a visual error, he is often confident that his response is correct, but when he makes a semantic error he usually has little confidence in the correctness of his response. A third form of error is the derivational error—here the stimulus is a syntactic derivation from the response or vice versa (responding "edition" to EDITOR, or "am" to BE). Some errors require a certain artistry for their interpretation—for example, "orchestra" for SYMPATHY; "music" for OVERTURN, or "taste" for FAVOUR. These are clearly a visual error followed by a semantic error.

Search for understanding

One ability which is very severely impaired in deep dyslexia is the ability simply to convert letters to sounds. The patient cannot pronounce aloud even the simplest of pronounceable nonsense words (RUD or GLEM). He cannot judge that SAIL and SALE rhyme, but decides that SEW and FEW do, and it is clear that he carries out such judgements by using the *visual* similarity between the terminal letters of a pair of words.

Early theoretical interpretations of deep dyslexia postulated a variety of defects in early stages of the reading process—what one might call *input* defects. Recent work, however, suggests more and more strongly that many of the difficulties may be at surprisingly late stages of the reading process—what one might call *output* defects. For example, when a patient misreads a function word, his response is very often another function word—one patient read TO as "which", OR as "with" and WHILE as "sometimes"; another MIEUX as "plus", TRES as "non" and LA-BAS as "parce". This must mean that in some sense these patients "know" that what they are looking at is a function word; input mechanisms work sufficiently well to provide this information, even though the patient appears unable to decide precisely *which* function word it is.

John Hughlings Jackson (1835-1911) and (inset) Joseph Jules Déjérine (1849-1917), pioneer investigators of dyslexia

A patient studied in Baltimore by Eleanor Saffran and her colleagues frequently made derivational errors by omitting the terminal -s from plural words or adding it to singular words, but could nevertheless indicate the correct number of a word by holding up either one or more fingers. When he responded "him" to ME he nevertheless pointed to himself. Karalyn Patterson has patients who cannot read many function words aloud correctly but nevertheless are virtually perfect at classifying as words and nonwords a series of 60 function words intermingled with 60 short pronounceable nonwords.

What we need in future work is more attention to how well these patients can *understand* printed words. One can detect whether a word can be understood without requiring the patient to pronounce it—for example, by asking him to mime the word, or to choose a picture which matches it. It may turn out that a considerable amount of comprehension is preserved despite the very limited ability to pronounce.

Evelyne Andreewsky has carried out the most spectacular work along these lines in Paris with a French patient. French has the useful feature that there are a number of words which have two meanings, one that represents a content word and the other a function word: for example, in French, CAR means "bus" as well as "because". This patient, when asked to read aloud the printed sentence LE CAR RALENTIT CAR LE MOTEUR CHAUFFE (The bus slows down because the engine overheats) responded "Car ralentit moteur chauffe", omitting all the function words. CAR was pronounced when it was a content word and not when it was a function word. In order to know that the first CAR was a content word and the second CAR a function word, however, the patient must have the ability to determine the parts of speech of the sentence. To emphasise this, the second CAR was replaced by a common concrete noun, MER (sea), which the patient could always pronounce when it was presented in isolation. This yielded the string of words

LE TRAIN RALENTIT MER LE MOTEUR CHAUFFE. Here the patient's response was "train ralentit moteur chauffe". Thus MER was treated as a function word; this would seem to imply that a syntactic analysis of the *sentence as a whole* has been carried out, and this analysis indicated to the patient that the short word linking the two clauses must be a function word, which prevents him from pronouncing it (and overrides the fact that this short word is actually a common concrete noun). Andreewsky's interpretation is supported by the fact that the patient refuses to begin to pronounce any word at all until he has seen the whole sentence—perhaps because only then can he execute a complete syntactic analysis.

If a concrete noun can be made unpronounceable by disguising it as a function word, could a function word be made pronounceable by disguising it as a noun? This was tried with the function word DONC disguised as a noun in LE DONC RALENTIT CAR LE MOTEUR CHAUFFE. This almost worked; the patient did produce the sound "mm" in attempting to pronounce DONC whereas no response to it would be made in isolation. Philip Johnson-Laird, of the University of Sussex, suggested a subtler way of doing the same trick. In the phrase SHE JUMPED UP, UP is clearly an individual function word, a preposition. In the phrase SHE RANG UP, on the other hand, UP is a particle which is an integral part of the verb RANG. Perhaps a patient could pronounce UP in the latter phrase and not in the former? If so, what about SHE RANG THE MAN SHE USED TO KNOW UP?

Although much more work needs to be done along these lines, the examples given above show that many of the difficulties of these patients arise at relatively "deep" levels, at stages that come after many of the processes involved in reading—hence the term "deep dyslexia".

Observations about deep dyslexia invite explanations, and I would like to conclude by posing a somewhat speculative interpretation. The prevailing view is that the left hemisphere system used in normal reading is partially damaged, but an alternative possibility is that the system is entirely inoperative: the neural pathways that permit contact between written representations of words and the left hemisphere reading system have been completely destroyed.

How the deep dyslexic reads

The deep dyslexic can read to some extent, so it would follow that he must be using a reading system located in the right hemisphere. A variety of evidence suggests that the right hemisphere does possess some limited linguistic abilities. Furthermore, this evidence provides some fragmentary indications that properties of this right hemisphere reading system resemble properties of the deep dyslexic's reading behaviour. For example, with normal subjects, when words are presented to the left hemisphere, the subject's ability to process them is not affected by whether they are abstract or concrete; but if they are presented to the normal subject's right hemisphere, abstract words are more difficult to deal with than concrete words. There is also evidence that the right hemisphere cannot convert letters to sound, whereas the left hemisphere can.

Because the one linguistic ability which appears to be entirely absent from the right hemisphere is the production of speech, one must suppose that the deep dyslexic generates his overt reading responses in the left hemisphere. Therefore, if the right hemisphere comprehends the words, it will need to communicate with the left hemisphere before the patient can make his vocal response. The question is, how does the right hemisphere code the information before it sends it on to the left hemisphere? The code cannot be orthographic (spelling), because my hypothesis says that orthographic access to the left hemisphere reading system is impossible. Nor can the code be phonological, because the right hemisphere cannot convert letters to sounds; that is, it cannot construct a phonological code. The only remaining candidate appears to be a *semantic* code. I suggest that a printed word contacts the right hemisphere reading system, which transfers the word's semantic representation (meaning) to the left-hemisphere system where it is used to locate the word within the system. This allows the patient to retrieve from the left hemisphere system the word's pronunciation, and hence to make a vocal response to a printed stimulus.

Suppose we show the word SMALL to a patient. Since this is synonymous with LITTLE, the semantic representation transferred from the right hemisphere cannot permit the left hemisphere to decide between "small" and "little", because they have identical semantic representations. Thus at least sometimes the response "little" will be selected when the word SMALL is presented, and vice versa. This is exactly what we have been calling a semantic error.

Not all semantic errors can be explained so neatly, because not all are synonyms. To explain responses such as "canary" to PARROT or "nord" to EST, we have to suppose that some semantic features—the lowest-level, most highly specific features—do not reach the left hemisphere, either because the information is lost in transit, or because it is not represented in the right hemisphere in the first place. The words "canary" and "parrot" are synonymous except for the most specific of their semantic features, those features which define precisely which domestic birds they are. Similary "nord" and "est" are both points of the compass; only the most highly specific of their semantic features define which point of the compass each is. Very many examples of semantic error can be understood as losses of the most specific semantic features: "crocus" for TULIP, "June" for MAY, "red" for GREY, "paint" for DRAW, "Diamant" for OR, "Hose" (trousers) for BLUSE (blouse)—a German patient—and "bud" for BLOSSOM, are some examples.

Linguists occasionally express the view that the semantic representations of function words are not as rich as those of content words, or even that function words do not have semantic representations in the same way that content words do. If so, it is perhaps not implausible to suggest that sometimes when a function word is presented to a patient, all that is transmitted to the left hemisphere is the single semantic feature "function word"; in which case the patient will be able to respond by uttering a function word, but will not know which function word is the correct one to say.

Japanese is written in a mixture of two quite different scripts: *kanji* (an ideographic script similar to the Chinese script) and *kana* (an orthographic script in which each symbol stands for a syllable). A Japanese deep dyslexic studied in Tokyo by Sumiko Sasanuma was found to be severely impaired in reading *kana* (spelling), but much less impaired in reading *kanji* (pictures). Studies with normal Japanese subjects by Takeshi Hatta indicate that the left hemisphere is better than the right at dealing with *kana*, while the right hemisphere is better than the left at dealing with *kanji;* thus *kanji* is superior to *kana* not only in the deep dyslexic but also in the right hemisphere, which is consistent with my view that the deep dyslexic uses his right hemisphere to read.

It remains to be seen how well these speculations will stand up as future work provides further information about the characteristics of deep dyslexia. Whatever the underlying nature of this syndrome turns out to be, however, it is already clear that its remarkable properties are now having a substantial impact on the ways in which experimental psychologists think about both normal and disordered reading. It is also clear that detailed study of the semantic and syntactic characteristics of the patients' attempts to read will tell us a great deal more about how linguistic information is represented mentally. ☐

Dowsing achieves new credence

Reports from the Soviet Union of successful scientific experiments in the ancient arts of water and mineral divining have forced a fresh look at possible practical applications of the technique

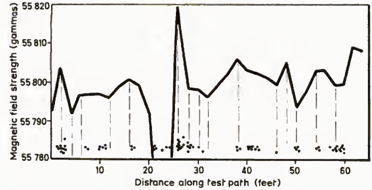
Tom Williamson
is a geologist with an interest in mineral prospecting

In 1974, two geologists from the All-Union Scientific Research Institute of Hydrogeology and Engineering Geology, Moscow, reported the results of mineral surveys in Karelia, the Ukraine and Tadzikistan, carried out using a variety of photogeological, geophysical and geochemical methods. The two scientists, N. N. Sochevanov and V. S. Matveev, emphasised the merits of one particular method recently developed in the Soviet Union and known as "BPM". In conjunction with other techniques, BPM anomalies, identified from the results of air and ground surveys, had proved extremely useful in pinpointing several worthwhile metal ore deposits. In a more recent paper, Sochevanov and three other Moscow geologists list many further applications of BPM, particularly to the successful siting of water wells. When it is added that BPM prospecting equipment is extraordinarily cheap, lightweight and simple in design, it seems astonishing that such an important new method should have been so ignored in the West. Ignored by the scientific community, that is to say. For, as it turns out, BPM (bio-physical method) is simply a respectable new name for water and mineral divining or dowsing!

The use of a divining rod—traditionally a forked hazel twig—as a prospecting tool, dates at least from the 16th century, when miners in the Harz mountains of Germany used it in their search for veins of copper, lead or tin ore. Contemporary mineral divining was well described by Agricola in his *De Re Metallica*, published in 1556.

> "All alike grasp the forks of the twig with their hands, clenching their fists, it being necessary that the clenched fingers should be held towards the sky in order that the twig should be raised at that end where the two branches meet. Then they wander hither and thither at random through mountainous regions. It is said that the moment they place their feet on a vein the twig immediately turns and twists, and so by its action discloses the vein; when they move their feet again and go away from that spot the twig once more becomes immobile."

Although controversial from the start and frequently attacked by the Church as the work of the Devil, the use of the divining rod in the search for ore veins persisted; in 18th century Germany mineral diviners were held in as high esteem as surveyors. By this time, the practice had spread to other European countries and had broadened to include the siting of wells. It is this application of dowsing that has flourished so much during the past century. Today, many thousands of wells throughout the world are sited every year by water divining—in fact, a rather misleading term for a technique that is alleged to be capable of locating zones of strongly flowing ground water as opposed to the "quasi-stationary" water always present in rocks below the water table.



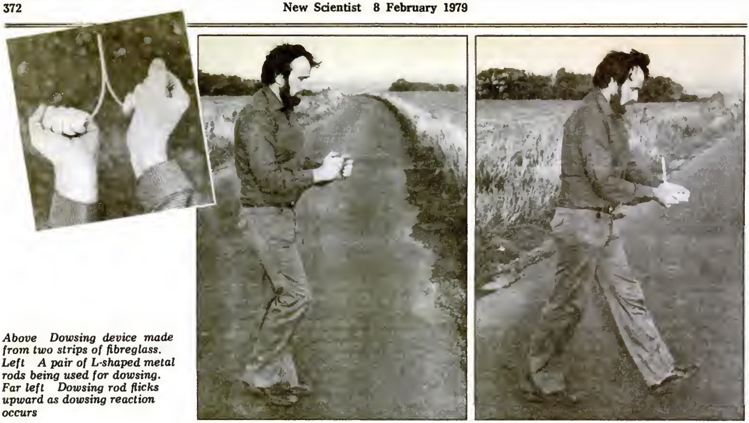
Magnetic field over test area. Dots show where dowsing reaction occurred

Illustration from G. Agricola's Treatise on Mining (1557)

Unfortunately, water diviners have not been prepared to master the rudiments of ground water geology or other relevant sciences, preferring instead to elaborate their own naive theories about dowsing. So they have never been able to present their claims in a form acceptable to scientists. Understandably, hydrogeologists and other scientists concerned with ground water supplies have traditionally viewed water divining with distaste or even hostility.

One way out of this impasse might be to shift attention away from the claims of practising water diviners towards a study of the dowsing reactions of ordinary people. It seems that the ability to obtain such reactions is far more widespread than had previously been thought. For example, in the BBC *Tomorrow's World* programme "Now You See It, Now You Don't", broadcast on 22 December, 1977, viewers were shown how to make simple L-shaped dowsing rods for themselves. Using these devices which, like the traditional hazel twig simply act as high-gain mechanical amplifiers of small hand movements, hundreds of people found that they could experience dowsing reactions. Of course, sceptics can maintain that the small hand movements of the dowsing reaction are entirely psychological in origin and that if they do bear any relation to the external environment it is only through information received along normal sensory channels. But the hypothesis that some dowsing reactions are direct physiological responses to small changes in the environment should also be considered. In the light of the suggestions, for example by Madeleine Barnothy of the University of Illinois and Alexandr Presman of Moscow State University, that some biological systems may have evolved a remarkable sensitivity to very small changes in ambient magnetic and electromagnetic fields, this hypothesis is not as implausible as might at first sight appear.

How could such a theory account for the phenomenon of



Above Dowsing device made from two strips of fibreglass. Left A pair of L-shaped metal rods being used for dowsing. Far left Dowsing rod flicks upward as dowsing reaction occurs

water and mineral divining, or BPM as applied by Soviet geologists? Mineral veins and flowing ground water are both associated with geological discontinuities such as faults, fracture and shear zones, prominent joint planes, old stream channels, solution cavities in limestones, lava tubes in volcanic rocks and so on. These discontinuities cause small geophysical perturbations, in magnetic field strength for instance, that could be responsible for the dowsing reaction. This is the belief of the Soviet geologists who have been using BPM for over a decade and whose work deserves to be better known in the West.

The first paper on BPM as applied to geological prospecting was published by V. S. Matveev in 1967 (*Isvestiya Akademia Nauk Kazakskoi SSR*, Ser Geol No 3, p 76). He described a series of standardised V-shaped metal frames, designed to rotate freely in the hands when the small hand movements of the dowsing reaction occurred. To carry out a BPM survey on foot, the geologist simply records the number of rotations within each unit of distance covered. In this way, Matveev obtained a series of BPM profiles across several copper-zinc sulphide ore bodies related to the Tasti Butak porphyry copper deposit in Kazakhstan. He selected areas where exploration drilling had revealed local geology in some detail, and compared BPM data with Bouguer gravity, magnetic, resistivity, and self-potential anomalies obtained along the same base lines. BPM data correlated better with the local geology than with any of the geophysical measurements, the largest BPM anomalies occurring where massive sulphide ore bodies approached the surface. So although this preliminary investigation shed little light on the physical nature of BPM, it did suggest that in mineral exploration the method could play a useful part in complementing geophysical data.

BPM quickly attracted great interest among Soviet geologists. Conferences on the subject were held at Moscow in 1968 and 1971; the second was attended by more than 100 scientists from 40 research institutes throughout the Soviet Union. But by 1971 it was becoming clear that BPM research was a far more formidable undertaking than it had seemed at first sight. The cooperation of scientists of many different disciplines was required; until such cooperation had been achieved, little progress in elucidating the physical mechanism of BPM could be expected. However, unperturbed by this lack of theoretical progress, Sochevanov and Matveev continued to develop BPM as a prospecting technique (*Geologiia Rudnykh Mestorozhdenii*, No 5, p 77, 1974). Two examples will illustrate their approach. A combined dowsing and photogeological helicopter survey was carried out of several hundred square kilometres of Precambrian metamorphic terrain in north Karelia, where rare mineral-bearing pegmatite bodies occur in association with a regionally developed migmatite complex. The angle of dip of a hand-held BPM frame was continuously monitored along a series of flight paths 250 metres apart. In conjunction with the air photographs, BPM anomalies—where angles of maximum frame dip were recorded—proved valuable in delineating local fracture zones, where rare metal mineralisation was subsequently proved by exploration drilling. In the Karaminsky mountains of Tadzikistan, where zones of polymetallic sulphide mineralisation occur in Upper Palaeozoic limestones and lavas, geochemical prospecting had already identified some interesting broad anomalies. Contour maps of BPM intensity showed maxima coinciding with geochemical anomalies, which were resolved in sufficient detail for successful exploration drilling to be carried out.

Lack of theoretical basis?

Sochevanov and his colleagues have listed (*Geologiia Rudnykh Mestorozhdenii*, No 4, p 116, 1976) many other examples of the successful application of dowsing in the Soviet Union, not only to the location of ore bodies but also to the siting of water wells and even to problems in engineering geology. For instance, in one region near Cheliabinsk, 1120 wells had, by 1973, been dug on sites suggested by four BPM operators compared with 158 on sites located by geophysical methods. The proportions of dry wells in the four BPM-sited groups ranged from 6 to 8·5 per cent, while 12·7 per cent of the geophysically sited wells were dry.

Despite its successes in the field, though, BPM is by no means accepted as a valid technique by all Soviet geologists. N. G. Schmidt, for example, has opposed it on the grounds of its unscientific nature, lack of theoretical basis and alleged links with the occult (*Geologiia Rudnykh Mestorozhdenii*, No 5, p 88, 1975). Another weakness pointed out by Schmidt is the repeated failure of experienced dowsers in the West to demonstrate their abilities under test conditions. Schmidt quotes the experiments reported by R. A. Foulkes (*Nature*, p 163, vol 229).

Foulkes's experiments, conducted on behalf of the UK Ministry of Defence, were primarily designed to assess the ability of dowsers to detect buried mines, in which they failed conspicuously. But a few tests were relevant to water divining. In one a dowser failed, in a series of 50 trials, to determine whether or not water was flowing in a small polythene tube beneath a lawn, and in a second test only one out of four student dowsers showed a small significant ability (at the 5 per cent probability level) to find buried 6-inch pipes containing flowing water.

In the same year in which Foulkes conducted his experiments in England, the results of a more comprehensive inquiry into the possibility of water divining were published in America by Duane Chadwick and Larry Jensen, two scientists at the Water Research Laboratory of Utah State University (*Utah Water Research Laboratory Progress Report* 78-1, p 57, 1971). The main aim of this study was to discover if dowsers could achieve results significantly different from chance. But instead of examining a small number of "experienced" dowsers as Foulkes did, the investigators tested the abilities of 150 novice dowsers, most of whom were staff and students at Utah State University. The dowsers, using L-shaped rods, walked one at a time along test paths selected for the absence of visual features or changes of slope that could provide subconscious cues for dowsing reactions. Each dowser was issued with 30 small wooden blocks, which he or she was instructed to drop at those places where dowsing reactions were obtained. Positions of the blocks were measured and, of course, the blocks were removed before the next dowser walked along the test path. To determine if there was any significant clustering of blocks, chi-square tests were performed on the results of four experiments along different routes. Much to the surprise of the initially sceptical investigators, three out of the four results were significant at the 0·05 per cent probability level, the fourth at the 6 per cent level. These results suggested that it would be worth examining the possibility that the dowsing reactions were related to small magnetic field variations along the test paths, as measured by caesium vapour magnetometers. Some correlation was found; dowsers obtained more frequent reactions along path segments in which larger magnetic field gradient changes occurred. Chadwick and Jensen concluded that the possible link between dowsing reactions and magnetic field changes related to flowing ground water could form the basis of future research.

In a subject as controversial and ill-defined as dowsing, distinguished by centuries of unbridled speculation and volumes of dubious literature, there are few facts. The recent Soviet work and the little-known Utah study have added considerably to the body of knowledge. Apart from providing good statistical support for the hypothesis that some dowsing reactions are direct physiological responses to small changes in the environment, the Utah researchers came up with the important finding that more than 99 per cent of the people they tested obtained dowsing reactions. If the dowsing reaction is as general as this, and if the Soviet claims as to the effectiveness of BPM as a prospecting technique are to be taken at face value, there would seem to be every reason for making water and mineral divining the subject of a concerted research effort. The Soviet geologists, who believe that the theory that dowsing reactions are related to weak electromagnetic fields may be the most fruitful idea to explore, have repeatedly pressed for the setting up of a Research Institute specifically devoted to BPM.

It does seem that only careful experimental work by a multidisciplinary team of the kind suggested by the Soviet geologists will ever make any progress in solving a problem that involves so many different sciences. The thesis that dowsing should be investigated in the context of electromagnetism surely deserves a more comprehensive experimental treatment.

What benefits might result from a well planned and carefully executed scientific investigation of water divining? Once the underlying principles were discovered, a cheap water prospecting technique as effective as BPM is claimed to be would have obvious application in the many regions of the Third World that depend on ground water. But if the solution of an age-old mystery, frequently linked with clairvoyance and the occult, were shown after all to be merely a question of thorough analysis it would be a timely demonstration of the value of scientific method. ☐

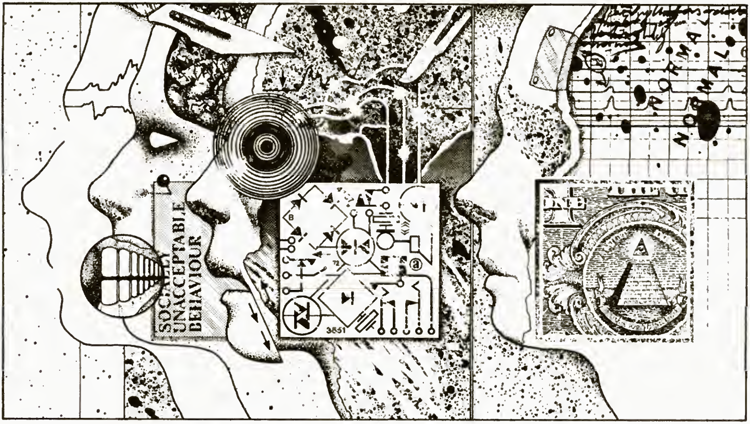
Various ways of holding the divining rod, shown in a French publication of 1693

"I, ..., declare myself bored stiff with the usual run of package holidays. Aren't other people as capable of exploring a Mayan city as they are of appreciating the Guggenheim collection? Now I want to hear more about this new **British Airways World Arts and Adventure Club.** It's going to bring people like me together with other travellers and offer some really interesting expeditions at highly attractive rates. Trouble is I'm not really a 'club' person. But it does sound like a chance to get more from a holiday than just a suntan, doesn't it?"

Address ....
....
Telephone No. ....

NSCT 82

World Arts and Adventure Club, British Airways
West London Air Terminal, Cromwell Road, London SW7 4ED.



Will Hill

The violence of psychosurgery

Twelve years ago two American neurosurgeons operated on Mr Leonard Kille's brain in order to "cure" his violence. The two surgeons are now in court defending their action in a $2 million case

David Patterson is a senior producer in BBC Radio. He recently visited the scene of the trial

The case *Geis v. Mark and Ervin*—now being heard in Boston, Massachussetts—is certain to become a *cause célèbre*. The plaintiff, Mrs Helen J. Geis is the mother of a man now diagnosed as a paranoid schizophrenic: he is under full time care at the Veterans Administration Hospital in Bedford—25 miles north of Boston. The defendants, Messrs Vernon Mark and Frank Ervin are two doctors who advocate surgical intervention to alleviate extreme forms of violence. The prime reason for the courtroom encounter is that in 1966 and 1967, these physicians performed on Mr Leonard Kille, at the time a 34-year-old engineer, a series of neurological procedures with the aim of curbing his violent behaviour. These procedures, according to the plaintiff lead to Mr Kille's "total incapacitation".

Apart from the magnitude of the suit—$2 million—the case is notable because of the broader issues that underly the contention of medical malpractice—issues such as whether a person diagnosed as mentally abnormal can give informed consent for neurosurgery; whether someone else can give consent by proxy; whether there is good scientific evidence on the efficacy of the procedures used; even whether or not society should condone or approve this kind of brain manipulation; and many other related issues of a legal, moral and scientific nature. The court's eventual ruling will undoubtedly bear heavily on those considering not just this, but all forms of surgery of a speculative nature in the future.

In the 15 years after the "invention" of psychosurgery in 1935, 20 000 people had their frontal lobes severed. Doctors were so adept at the operation that it became an almost trivial "outpatient" affair, to be done in the doctor's own surgery. The patient was numbed electrically and a sharp instrument, not unlike a miniature ice pick, was insinuated between the eyeball and the upper eyelid. The instrument was then given a sharp blow with a hammer driving the point through the thin bone that surrounds the eye socket. Once inside the cranial vault, the ice pick was waggled to and fro, an action not unlike that used in slaughterhouses after an animal has received the *coup de grace* from a captive bolt humane killer.

In the early days of this form of behaviour modification, it was not unheard of for judges to recommend the procedure for "difficult" criminals. Yet the operation did attract some criticism. In 1951, for instance, a prominent Soviet psychiatrist condemned it as "an antiphysiological method that violates the principles of humanity and makes the patient an intellectual invalid . . . an insane person is changed into an idiot." The Soviet Union in fact banned the procedure. Contrariwise, in the United States one of the most forceful proponents for psychosurgery, Dr Walter Freeman, suggested that it was better for the patient to have a simplified intellect capable of elementary acts, than an intellect where there reigned the disorder of subtle synthesis. "Society can accommodate itself," he wrote, "to the most humble labourer, but justifiably distrusts the mad thinker . . . lobotomised patients make rather good citizens." Freeman claims to have done over 3500 such operations.

Of course, the surgical procedures have been refined greatly in the past 25 years; the zone of destruction has been reduced considerably. The neurosurgeons now aim to destroy relatively small regions of brain tissue in the hope that undesirable side effects will be minimised. The explorations and surgery performed on Mr Kille's brain by Drs Mark and Ervin, at the time both professors at the

Harvard Medical School, were of this limited kind.

Mr Kille was by all accounts, a rather creative fellow—he was the author of a number of patents and the father of seven children. The jury in the trial heard of Mr Kille's medical history which culminated in his referral to the Massachussetts General Hospital in 1966. He is alleged to have had epileptic seizures, to have directed his violent rages towards his wife and was diagnosed as suffering from temporal lobe epilepsy. However Dr Robert Grimm of the University of Oregon, testifying for the plaintiff, argued that on the basis of the medical records, such a diagnosis was not correct. Another psychiatrist called by the plaintiff specifically suggested that at the time, Mr Kille was a paranoid schizophrenic, not a temporal lobe epileptic.

Stimulation produces symptoms

This diagnosis of temporal lobe epilepsy made in 1966 will probably be the key to the outcome of the suit. Drs Mark and Ervin in a book they published in 1970, *Violence and the Brain,* suggests that the changes of mood preceding the seizures in those who suffer temporal lobe epilepsy are closely paralleled in those people who have "temporal lobe disease", yet who do not suffer the seizures. They wrote that they were able to simulate all the signs of temporal lobe disease, including the violence, by stimulating electrically a part of the limbic (or mid) brain known as the amygdala.

In fact by stimulating different regions in the amygdala, Mark and Ervin were able to start and stop violent behaviour in their patients. They wrote "the first time we were able to demonstrate that systems in the limbic brain that both start and stop attack behaviour was with patient Thomas R. . . . Thomas's chief problem was his violent rage . . . he often felt that people were gratuitously insulting to him; when he was driving to work in the morning, for instance, and another car cut in front of him, he would take it as a personal affront. Nor was he willing to let any such insult go unpunished. He would speed after the other driver, weaving in and out of the traffic, threatening pedestrians, and going through stop signs until he finally caught up the driver and forced him to the side of the road. If the other driver were a man, Thomas would hit him; if it were a woman, he would insult her." Later Thomas is described as having picked up his wife and on numerous occasions thrown her against a wall, even when she was pregnant.

Dr Mark has already told the court that even though some details of the case history of Thomas R described in *Violence and the Brain* have been changed, Thomas R is in essence Leonard Kille. For seven months, the doctors at the Massachussetts General Hospital tried all manner of drug therapies in attempts to alleviate the patient's violent behaviour—to no avail. Drs Mark and Ervin then resorted to a regime of surgery on Mr Kille's brain.

In their book, Mark and Ervin argue that people who display repeated episodes of personal violence have brains which do not function in a "perfectly normal way". In this manner, they manage to define personal violence as essentially a medical problem: it is a subtle change of emphasis because if you say someone's behaviour is wrong or immoral, it is clear you are making a straightforward value judgment, but if you say it is unhealthy and therefore unwelcome on simple humanitarian grounds, the phenomenon is made a medical one and medical intervention becomes the appropriate action.

Mr Kille, being the butt of this line of argument, had electrodes passed down into his limbic brain so that the various parts of his amygdala could be explored. In all, 22 zones on the almond shaped nucleus were stimulated—some stimulations inducing tooth ache and loss of control, others inducing confidence, calm, elation, even unreality. In fact by stimulating electrically Thomas R's lateral amygdala every day, he was kept free from rage for two months. A daily "dose" of stimulation for the rest of the patient's life was out of the question, so the doctors suggested to Thomas that they ought to make lesions in the parts of his amygdalas (there is one in each hemisphere) which when stimulated brought on a rage. This suggestion was made to the patient when he was being relaxed by stimulation of the lateral region of an amygdala and under this circumstance, he agreed to the proposed plan. But Drs Mark and Ervin then write, "12 hours later when the effect had worn off, Thomas turned wild and unmanageable. The idea of anyone's making a destructive lesion in his brain enraged him. He absolutely refused any further therapy, and it took some weeks of patient explanation before he accepted the idea of bilateral lesions being made in his medial amygdala. Four years have passed since the operation during which time Thomas has not had a single episode of rage. He continues, however, to have an occasional epileptic seizure with periods of confusion and disordered thinking."

Medical records of Mr Kille's subsequent history describe how he has hallucinations about "microwaves coming from Harvard and MIT to murder him", and he believes he still has controlling electrodes in his head.

In one sense, this "hallucination" is not so fantastic since Mr Kille was one of the first people to have a remotely controlled electrical stimulator implanted in his brain—not unlike the device developed by Dr Jose Delgado in the 1960s: with his instrument, Dr Delgado was able to provide an extraordinary demonstration of the power of electrical brain stimulation by "switching off" the charge of a bull in full flight. Indeed, Mr Kille is probably the source of inspiration of the novel *The Terminal Man,* written by Michael Crichton—an alumnus of the Harvard Medical School at the time of Mr Kille's operation. Crichton's "hero" had 40 electrodes implanted in his brain, but through some miscalculation he became a homicidal maniac for three minutes every day. From the evidence so far presented in court, Mr Kille did not become like the hero of *The Terminal Man:* Dr Grimm testified that Mr Kille had his brain so damaged that he no longer has the capacity of short-term memory, "he is utterly dependant, unable to function in the day-to-day world". In the extensive coverage of the case in *The Boston Globe,* Dr Grimm is reported as saying that Mr Kille displayed symptoms of tardive dyskinesia, a condition brought on by the heavy use of tranquilising drugs which conspire to produce grotesque, even nauseating facial movements. These medications were used to treat Kille's condition of paranoid schizophrenia.

The specific issue that the Boston court has to address is that of malpractice. Such a suit may be fought on one or more of three grounds; that informed consent was not obtained; that the performance of the operation was negligent; that the method of review was negligent, ie was the operation, in the opinion of those qualified to judge, necessary?

Mrs Geis, the mother of Mr Kille has contended that her son did not give consent for the operation and that the risks involved in the procedures were inadequately explained. She also adds that she gave no consent by proxy. Furthermore, the plaintiff suggests that the defendants' diagnosis was of a condition never suffered by her son and so he was given an entirely inappropriate treatment. The defendants argue that the diagnosis was correct and that the procedures used were reasonable given the state of medical knowledge and practice at the time. In addition Dr Ervin states that both Kille and his wife were informed of the risks and benefits—a one in three chance of a diminution of his violent seizures, of his being free from seizures or having no improvement or becoming worse. This deposition of Dr Ervin appears to be in conflict with a statement in Dr Mark's deposition which described the technique as "a new and experimental procedure. We have had too few patients to give any reliable data about the likelihood of success".

The Solomonic decision that will have to be made by the court will be based on the rather narrow issues subsumed by a malpractice suit: yet waiting in the wings are questions, the resolution of which may depend crucially on the findings of the jury which has been hearing evidence since 6 November, 1978.

Should all surgical procedures be evaluated with the same scrupulousness that is now mandatory for new drugs? Certainly there have been few, if any, controlled trials of the forms of psychosurgery that involve destruction of parts of the amygdala. The National Commission for the Protection of Human Subjects of Biomedical and Behavioural Research when it was set up by the 1974 National Research Act of Congress was enjoined, among other things, to study the efficacy of psychosurgery. Reviewing the three studies contracted out by the Commission, lawyers George Annas, Leonard Glantz and Barbara Katz in their book *Informed Consent to Human Experimentation* conclude that psychosurgery sometimes works, but that no one knows why. They also suggest that while modern psychosurgery may be relatively safe, the question of its effectiveness still remains.

These authors also are critical of the Commission's final report on psychosurgery published in 1977. They point out that it fails to deal with the circumstances, if any, under which psychosurgery should be permitted on individuals who could not give informed consent even were the effectiveness of the surgery eventually demonstrated. They also question whether there is a constitutional right for an individual to be the subject of experimental psychosurgery.

Will these forms of behavioural modification, if that is what they are, become proscribed in the United States? The medical lobby in the United States is beginning to protest on virtually jingoistic grounds that the constraints placed upon American neurosurgeons are allowing European psychosurgeons to advance their methods beyond those available in the United States. Already the states of California and Oregon have all but banned psychosurgery —a lobbying victory claimed by the Scientology movement.

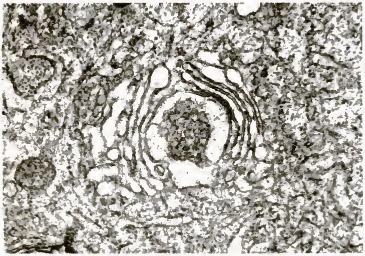
The resolution of all these matters will depend on finding solutions to some rather surprising philosophical and moral problems: as with many psychiatric therapies, is it possible in psychosurgery to devise a scientifically valid trial of the methods advocated without doing injury to our cherished ethical precepts of informed consent? That question gives rise to another at the centre of the heated debate over sociobiology—are its methods scientifically valid—how seriously should we take the contention that there are "violence centres" in peoples' brains. Even if the answer to that question is Yes, we will still have to decide on our stance towards the morality of attempting to control behaviour by irreversibly damaging the brain. ☐

Proteins have export problems too

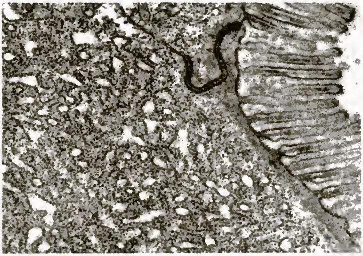
Cells manufacture all manner of proteins, some of which they use themselves while others are dispatched to other parts of the body. How does the cell "know" where proteins are to go

Dr Robert Freedman To microscopists, a living cell, with its amazing internal complexity and its multiplicity of distinct components, is a potential image of beauty and wonder. But to a biochemist, dedicated to the analysis of such a cell in terms of its molecular composition and chemical functions, it is even more awe-inspiring and puzzling. For each sub-cellular compartment, each internal structure carries out a defined set of functions and these functions are more or less determined by the proteins present. This makes it clear that the manufacture and transport of proteins is one of the cell's most important tasks. And recent work is beginning to hint at the means by which proteins are directed to their "proper" places in the cell.

At first sight it might seem convenient for every sub-cellular entity to manufacture its own proteins. But this would require that these entities all contain the machinery for making proteins in addition to the equipment needed for their own specialised functions. In fact, although a very small number of proteins are made "on site", most of the proteins required for the functions of all sub-cellular structures are made in the cytoplasm, the area between the nucleus and the cell's outer wall. Proteins required in the nucleus to regulate cell division, proteins needed in the mitochondria to catalyse oxidation of foodstuffs, proteins contained inside lysosomes and responsible for "intra-


Diane Mclaren/MCR

Electron micrograph showing a Golgi body, an onion-like structure of membranes forming a conduit



Section through a host of endoplasmic reticulum membranes studded with ribosomes (dots in the picture) cellular digestion"—all are manufactured by ribosomes located in the cytoplasmic compartment.

Of course this raises a major problem of logistics. How is it ensured that the different proteins move reliably to their proper cellular destinations? And what of the numerous types of proteins which cells manufacture and then secrete? We have only to think of the digestive enzymes of the gut, the antibodies, hormones and blood-clotting proteins in the blood-stream, and the extracellular structural proteins such as collagen, to realise what an enormous problem this is. And it is not confined to the obviously complicated multicompartment cells of higher organisms. Even bacteria face it to some extent.

Many bacteria are surrounded by an inner membrane beyond which is a complex outer membrane. Between the two is a region called the periplasmic space. These localities each contain different and characteristic sets of proteins. Even some viruses, usually thought of as the simplest form of life, have to ensure that newly synthesised viral proteins go to the correct destinations in the cells they infect (their host cells), so that new virus particles can be constructed.

Any number of speculative schemes could be designed to explain how a cell carries out the major task of protein distribution. But it is now beginning to appear as if a single strategy is used in all these various situations. The strategy involves sections of proteins known as signals.

The evidence for this notion came first from studies on animal cells that manufacture proteins and then export them. Cells which secrete a lot of protein contain an extensive intracellular membrane known as the endoplasmic reticulum. In these cells, many of the ribosomes (the structures on which proteins are synthesised) are attached to one surface of the endoplasmic reticulum, rather than being simply free in the cytoplasm. Studies with radioactive tracers show that proteins to be secreted first appear *inside* the space created by the endoplasmic reticulum and then follow a defined route via the Golgi complex before being secreted (Figures 1 and 2).

For secreted proteins the *mechanism* of distribution is clear, but biologists realised recently that there was a second *informational* aspect of the problem which remained mysterious: What sorts out the external from the internal products? What is the cellular analogue of the internal and external mail trays? Does some cellular post-person make an individual judgement on each package? Or are the external products already stamped?

A ticket for export

Several years ago, David Sabatini and Gunter Blobel of Rockefeller University, proposed that nascent proteins (proteins in the course of being synthesised) themselves ensured their correct distribution. Sabatini and Blobel suggested that in proteins destined for export, the first part of the protein to be synthesised (the N-terminal region) would have the property of specifically attaching the growing protein chain to the membranes of the endoplasmic reticulum. In this way, the ribosomes involved in the synthesis of such a protein would become bound to the membrane and the newly synthesised protein would pass through the membrane and be committed to the export route. The obvious thing to do was to check whether the N-terminal region of export proteins is different from that in products. It isn't! They therefore suggested: (*a*) that nascent export proteins have a short chain of amino acids attached to their front ends; and (*b*) that this chain, a signal as they called it, is snipped off once the protein has attached itself to the endoplasmic reticulum and has begun to pass through to the export space.

In order to test their so-called signal hypothesis, Sabatini and Blobel needed to get hold of an export protein that had not passed through the export gate and would therefore still have its signal sequence attached. To do this they decided to isolate a messenger RNA (mRNA) coding for such a protein and to use it to manufacture its natural product in the absence of the endoplasmic reticulum.

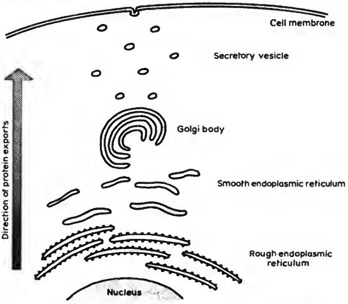
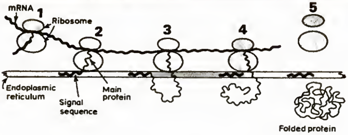

Cell membrane
Secretory vesicle
Golgi body
Smooth endoplasmic reticulum
Rough endoplasmic reticulum
Nucleus
Direction of protein exports

Diagram showing the route taken by proteins on their way from point of manufacture to export from cell. The rough endoplasmic reticulum, smooth endoplasmic reticulum and Golgi are a continuous conduit

In the early 1970s there was one piece of direct evidence favouring the hypothesis—the mRNA for one chain of an antibody molecule had been isolated and when it was translated in a test-tube system, the product was slightly larger than the authentic antibody chain. (The extra section might be the signal.) But in the period since 1975 an immense body of evidence has accumulated which entirely confirms the hypothesis. Messenger RNAs for many secreted proteins have been isolated: some for digestive enzymes, others for hormones, transport proteins, antibodies, nutritional proteins or eggs and milk and one for a bee venom protein (see *New Scientist*, vol 79, p 618). When these messengers are translated in test-tube systems, they yield (with a single inexplicable exception) products slightly larger than the mature proteins. By analysing the structure of these so-called pre-proteins, which are usually only available in minute quantities, researchers discovered that they differ from the natural proteins only in having a stretch of about twenty additional amino acids at the N-terminal end. This pre- or signal-sequence, it turns out, is rich in non-polar amino acids, an ideal structure with which to bind to the fatty surface of membranes.

During the past three years the signal hypothesis has become accepted as the explanation of how proteins to be secreted from animal cells are segregated and committed to the route leading them to their destination. But this does not directly answer the problem of how proteins are accurately distributed *within* cells. There is now a lot of suggestive evidence that a similar sort of mechanism operates. First of all, if you inject proteins into the cytoplasm of large egg cells of amphibians, the nuclear proteins make their way to the nucleus and the cytoplasmic proteins stay in the cytoplasm. This spontaneous migration implies some kind of directive mechanism built into the proteins. But more precise evidence has come from work on protein synthesised in plant leaf cells which plays an important role inside chloroplasts, the sub-cellular structures responsible for photosynthesis.

The crucial enzyme of photosynthesis, the one which catalyses the reaction in which carbon dioxide is captured and incorporated into an organic molecule, is ribulosebiophosphate carboxylase (RBPCase). This enzyme is the



Manufacture of proteins by ribosomes attached to the rough endoplasmic reticulum by the signal sequence

major protein in chloroplasts and actually makes up 50 per cent of the total soluble protein in leaves.

RBPCase is constructed from two subunits, one large (molecular weight 55 000) and one small (molecular weight 14 000). Intriguingly, the genetic message for the large subunit is carried on genetic material *in the chloroplast*, but the genetic instructions for the small subunit are located *in the nucleus*. The large subunit therefore seems to be manufactured where it is needed (in the chloroplast), whereas the smaller one is synthesised in the cytoplasm and only then does it travel to the chloroplast.

Early in 1978 two groups independently published results showing that the small subunit of RBPCase is derived from a larger precursor. Both Peter Highfield and John Ellis of the University of Warwick, and A. R. Cashmore and colleagues in Palmerston North, New Zealand had isolated messenger RNA from pea seedlings and translated it into protein in a test-tube system. Both had found that one of the major products was a protein of molecular weight 20 000. Highfield and Ellis then went on to show that this protein is recognised by antibodies that are specific for the small subunit of RBPCase. And when they incubated the 20 000 molecular weight protein with chloroplasts it was converted to a smaller protein with a molecular weight of 14 000; it was, in fact, identical with the authentic small subunit. Presumably, the part (or parts) of the precursor protein removed during this incubation is some kind of signal ensuring the transport of the large protein to the chloroplast.

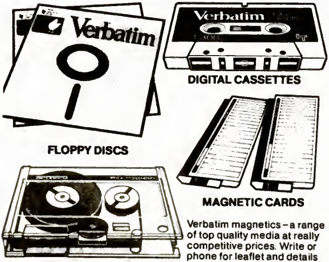
Similar results to this are turning up elsewhere. For instance the enzyme glutamate dehydrogenase, which functions right inside the matrix of mitochondria, is nevertheless made on ribosomes attached to the endoplasmic reticulum. Preliminary studies on the newly synthesised enzyme isolated from the endoplasmic reticulum show that it differs from the mature protein in the mitochondrion in its ionic properties and in its affinity for membranes. However, its molecular weight is very close to that of the mature mitochondrial protein. Presumably, only minor modifications occur during transport to its ultimate destination. In bacteria, too, several proteins which are exported into the outer membrane have been shown to have larger "pre" forms. In one case, as for mammalian secretory proteins, the additional polypeptide is in a single stretch at the N-terminal end.

So the general significance of the "signal" mechanism for the distribution of newly synthesised proteins is established beyond doubt. But three important problems remain. First, what are the differences between the signals operating in a single cell and ensuring despatch of different proteins to their characteristic destinations? To answer that will require structural analysis of precursor forms of a large number of varied proteins. Secondly, what is the actual mechanism which takes a protein out of one cellular compartment, across a membrane and into another compartment? For secreted proteins we have the clue that the signal sequence is highly hydrophobic (soluble in fat), so it is easy to envisage how this sequence buries the leading end of the protein into the endoplasmic reticulum membrane. But beyond that any mechanisms describing the translocation of the whole protein are purely speculative.

Finally, there is the intriguing question of the nature and location of the processing reactions in which the various signal sequences are excised. For the secretory proteins there is good evidence that the endoplasmic reticulum must be present while the protein is being synthesised in order that correct processing can occur: for instance, in a laboratory experiment it is not sufficient to translate the messenger RNA in a test-tube system and then add fragments of the membrane. Furthermore, if vesicles made from the endoplasmic reticulum are present during translation, the newly synthesised protein ends up *inside* them. In other words, in such cases, the synthesis of the protein is accompanied by its movement across the endoplasmic reticulum and its processing to remove the signal sequence.

One can therefore envisage some kind of integrated system for binding the signal sequence to the membrane, passing it through the membrane, pulling the remainder of the protein behind it, and finally for removing the signal sequence when enough of the main protein sequence has been made. Biologists are now beginning to characterise this specific protein-splitting activity, and the earliest results show that, as expected, it is located on the "inside" of endoplasmic reticulum membranes.

But this still leaves an enormous number of questions unanswered. The enzyme in chloroplasts which trims the precursor of RBPCase's small subunit can operate even if the completed precursor is added to chloroplasts. So here a rather different mechanism must be operating. Perhaps the experiments now going on to illuminate this and related questions will produce an outline for a new major chapter in cell biology. □


magnetic media from
WILLIS

Verbatim
FLOPPY DISCS
DIGITAL CASSETTES
MAGNETIC CARDS
DATA CARTRIDGES

Verbatim magnetics – a range of top quality media at really competitive prices. Write or phone for leaflet and details of our filing equipment.

WILLIS
Willis Computer Supplies Ltd.,
PO Box 10, South Mill Road,
Bishop's Stortford, Herts
CM23 3DN. Tel: 0279 57621
Telex: 817425.

PHYSICS IN NEW YORK

The 1979 joint annual meeting of the American Physical Society (APS) and the American Association of Physics Teachers (AAPT), held last week, tackled topics from nuclear fusion to parapsychology: Ros Herman reports

Renormalising Chinese physics at Fermilab

Leon Lederman, director designate of the Fermi National Accelerator Laboratory in Illinois, has two things on his mind at present. The first is to make certain that he maintains his personal tradition of working at the world's most powerful accelerator, and the second is the care of 40 physicists from the People's Republic of China (or the PRC to use the local jargon), who are coming to Fermilab to learn how to build accelerators.

Speaking at a luncheon of the US National Association of Science Writers, he said that the equipment, now being built to boost the available energy of protons circulating in Fermilab's main accelerator, was "beyond the state of the art". He was referring to the superconducting magnets whose strong magnetic field will make it possible to accelerate protons to 1000 GeV, twice the present energy limit of 500 GeV, without increasing the size of the ring. Over 100 magnets have now come off the "production line" at Fermilab, but 1000 are needed for the complete system.

"Every day there is a new first", said Lederman. Recently, for example, scientists at Fermilab set up 25 of the superconducting magnets in an intense particle beam. As soon as the beam hit the magnets they "went normal", that is they lost their superconducting property of zero electrical resistance, and began to lose strength as part of their energy was dissipated as heat. To Lederman and his colleagues, this is just one of the minor setbacks that pioneers can expect.

The Chinese physicists will be using Fermilab as a base from which to tour "those few laboratories left", to quote Lederman, which have up to date expertise in the technology of high energy physics. They hope to use what they learn to enable them to jump straight into the front rank of world accelerators, without negotiating the nursery slopes up which Europe and America have carefully progressed during the past 30 years. The Chinese wish to build a 50 GeV proton accelerator, on the outskirts of Peking, which they plan to have complete by 1988. But they are already looking beyond that goal, towards a bigger ring, to take the proton energy up to 300 GeV, planned to be ready by 1990. ☐

Leon Lederman, director designate of Fermilab

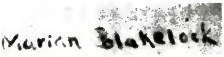
Neutrons reveal a cover-up

Paintings and manuscripts can be made to yield vital clues about their date and authorship through the use of neutron beams. Maurice Cotter, of Queen's College at the City University of New York, has given works of art a hefty dose of thermal neutrons and then watched as the beta-rays and gamma rays from the irradiation form an image over a period of weeks on a photographic film placed over the canvas or parchment. By analysing the energies, intensities and decay rates of the radiation, Cotter can establish chemical details of the materials used, and describe when, and in what order, work was done in different areas of the picture.

The technique was first suggested in the early 1960s by Heather Lechtman of the Massachusetts Institute of Technology, when she was working at the Institute of Fine Arts of New York. Lechtman found that the results from activation by neutrons were significantly different from those produced by X-rays. She also established that the dose of neutrons—over 25 times that of Cotter's test—did not damage the art works.

The first step in the examination is to irradiate the work of art at the patient port of the medical reactor at the Brookhaven National Laboratory. With an average flux of 10^9 neutrons/cm^2/sec over a period of $1\frac{1}{2}$ hours, the resulting radiation dose is 200 rads. Cotter counts the gamma rays coming off to establish which radionuclides have been produced. He then takes a series of autoradiographs over the next few weeks. As the radionuclides with shorter lives decay, new ones are produced which can be seen in the later autoradiographs. Cotter can then sort out which pigments are present, and how they are distributed over the painting. He can in this way build up a knowledge of a technical "signature" of the artist. Any major deviation of this would tend to cast suspicion on the authenticity of a canvas.

The paintings of the American artist Ralph Blakelock (1847-1919) presented Cotter with an interesting problem. There are many "Blakelocks" around, but art experts generally agree that many of them are forgeries. Could neutron activation analysis establish some criteria by which a scientific judgement could be made on any particular canvas? After studying many "Blakelocks", Cotter has come to the conclusion that in many cases this can be done. He showed one picture where neutron analysis revealed clear signs, at one corner, of a name that someone had tried to erase. The marks that remained bore a close resemblance to the signature of Blakelock's daughter, Marion, as it appears on her own paintings. Cotter concludes that a forger has tried to pass off the work of the daughter as that of the father, as many art experts already suspected.



Usual signature of Marion Blakelock

Partially erased signature revealed by autoradiograph

In another case, Herbert Muether and Nandor Balaz of the State University of New York at Stony Brook have worked with Cotter to apply the method to the study of manscripts. The first work to come under careful scrutiny was that of "The Spanish Forger", a 19th century artist who painted manuscript illuminations which he passed off as the work of artists of the 14th to 16th centuries. The team showed that he consistently used a green pigment, copper arsenite, which was not available until 1814. Future research will be aimed at using trace elements to date the manuscripts by neutron activation analysis and X-ray fluorescence.

Now the method has been standardised, art historians at the Metropolitan Museum in New York are using it to study works by Rembrandt and other Dutch 17th century artists. It can also suggest how damaged paintings should be restored to be as close as possible to their original state. ☐

Photovoltaics stay in the lab

Converting the Sun's energy directly to electricity is still at the research and development stage, according to a report prepared by an American Physical Society study group for the Office of Science and Technology Assessment (OSTA) and the US Department of Energy (DOE). None of the currently available technical options for photovoltaic conversion seems an obvious choice, says the study, and it concludes that "efforts to stimulate a large scale low cost industry are premature". One per cent of the total US electricity consumption is the maximum contribution photovoltaics can make by the end of the century, the group estimates.

These conclusions—by a group of distinguished physicists who work for companies and in university teams not directly concerned with photovoltaic energy conversion—are likely to stir up a hornet's nest of opposition among researchers who want to push ahead fast to get costs down and efficiencies up. David Adler, a physicist working on materials for photovoltaic devices described the APS group's prediction for energy contribution as "a self-fulfilling prophecy." He believes that the time is now ripe for commercial production to begin.

However, Henry Ehrenreich of Harvard University, chairman of the APS study group, believes that a preliminary report based on its findings—presented to the DOE last September—was instrumental in getting the research budget for photovoltaics increased in the recently announced science budget. Ehrenreich said that prospects for photovoltaics as an energy source are very bright in the long term. Unexpected recent developments such as the amorphous silicon hydrogenated silicon cell (*New Scientist*, vol 80, p 672 and 760) and gallium arsenide liquid junction cells may well advance photovoltaic energy conversion "to the position of a dominant technology rather than a relatively minor component in the US energy mix", the report says. But major advances are still needed in the technologies of crystal silicon cells and the cadmium sulphide/copper sulphide system, at present the most promising thin film material.

The study group criticises the way DOE has organised research into photovoltaics. "The funding formats have been too goal-oriented, over managed, and too restrictive". "The best ideas will be generated in the research community and are not programmable by the agency", it says.

The report suggests that systems in which concentrators focus radiation from a large surface area onto a small cell are an important area for future research. The group believes that concentrator systems are less advanced than conventional photovoltaic devices and congratulates DOE on its decision to put more cash into their development.

The report mentions the results recently published in *New Scientist* and *Nature* (vol 276, p 483) by Stanford Ovshinsky, on the properties of amorphous materials doped with hydrogen and fluorine. Although it says the results bode well for increasing the conversion efficiency of cells, they came too late to be an important factor in forming the study group's conclusions. □

Trapped quarks defy hunters

All quark searches are doomed to failure according to Gerard 't Hooft of the Institute of Theoretical Physics at the University of Utrecht. He claims that if objects with fractional charge *are* found they will *not* be quarks, the fundamental constituents of matter proposed by theoreticians.

In his lecture as 1979 winner of the Heinemann prize for mathematical physics, awarded by the American Institute of Physics and the American Physical Society, 't Hooft described how the theory of superconductivity can explain why we have never seen quarks individually.

As superconductors are cooled down their electrical resistance falls to zero and all magnetic fields are pushed out of the material. Some theorists say that the field between quarks behaves like the field between the poles of a magnet which becomes confined to the magnet when surrounded by a superconducting medium. Narrow unbreakable bonds form when the force fields between the quarks tighten, tying the quarks together as if by elastic strings that can switch position, but cannot be broken.

Avid programme readers might have expected a more psychological approach from the published title of "How quarks find themselves". The purists' interest was revived by 't Hooft, with the words "permanently trapped"—which were lost on the way to the printers! □

Breeding fuel from hybrids

Nuclear fusion reactions could be exploited as an energy source, even before it is technically feasible to build power plants based on fusion. James Maniscalco, of Exxon Research and Engineering Company at Linden, New Jersey, said that laser driven fusion "breeders" with a performance an order of magnitude lower than that required for electrical power production, could produce fissile material. He foresees that such a system could be in operation by the year 2014.

In this technique, the neutrons emerging from fusing nuclei are used to transform the non-fissile materials in the blanket surrounding the fusion region. The same radioactive isotopes are produced as are used to initiate the fission process in nuclear reactors. The fusion reaction, in this way, is used to "breed" nuclear fuel from nuclear waste. For example, uranium-235 which is normally discarded after the fissile material ^{235}U has been extracted, would form plutonium-239 after bombardment by neutrons. Similarly, ^{233}U, another fissile material, would be produced from thorium-232.

Advantages of this "hybrid" system over the fission breeder reactor, another system designed to extend uranium supplies, were suggested by Ralph Moir of the Lawrence Livermore Laboratory in California. He said that a 4000 MW thermal fusion reactor could produce 2·5 tons of ^{233}U per year, which is enough to support twenty 1000 MW nuclear fission reactors. Current designs for fission breeders would fuel only one or two reactors. He also pointed out that it would be reasonable to site a fusion breeder away from centres of population, as it would not need to supply electricity.

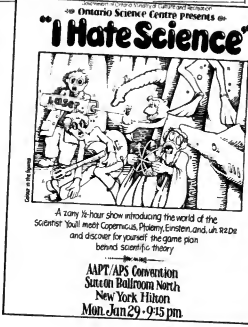
Despite its prospects as a stepping stone to fusion power, and as a way of eking out nuclear fuel supplies, the hybrid concept has not been taken up by the nuclear fission community or by researchers working on fusion power; nor has the Department of Energy provided any guidance. Maniscalco said that the fission industry should develop the idea, but at present the companies have more pressing problems; the US nuclear export business has almost completely dried up, as a result of President Carter's policy of restricting the reprocessing of spent nuclear fuel. □

I hate science

Big Bad Bob found science boring and pointless until he was converted to guarded enthusiasm by his three eccentric scientific friends. Judy Douglas, Greg Rist, and Martha McGloin with Bob McDonald of the Ontario Science Centre presented their improvisation, "I hate science", as a nightcap after the session on public understanding of science. The audience responded with guffaws of laughter, and applause.

The group wants to put over that science is fun, useful and exciting. At the same time as showing how science gives answers about the world, they poke gentle fun at the way scientists stick to ideas that are wrong until experimental results finally force them to change their minds.

Before the trip to New York the group had performed only in Ontario, but they hope to take the show on the road more often in future. □



Government of Ontario Ministry of Culture and Recreation

Ontario Science Centre presents

"I Hate Science"

A zany ½-hour show introducing the world of the scientist You'll meet Copernicus, Ptolemy, Einstein, and, uh. R2D2 and discover for yourself the game plan behind scientific theory

AAPT/APS Convention
Sutton Ballroom North
New York Hilton
Mon. Jan 29 · 9:15 pm.

Testing parapsychology

Physicists are to test findings which indicate that individuals can significantly affect the outcome of what should be random phenomena. Paul Horowitz, incoming chairman of the American Physical Society's forum on physics and society, announced that he would welcome volunteers to help him check out and attempt to repeat the results of Helmut Schmidt. Schmidt, of the Mind Science Foundation, San Antonio, Texas, found that certain people can influence the outcome of an "electronic coin flipper", in that the results differ significantly from an even "heads" and "tails" score. His best results so far have come from a girl who scored 52 per cent (as against a chance expectancy of 50 per cent) in a series of 6400 tests over ten days.

Horowitz, a physicist at the AVCO Everett Research Laboratory, said that if effects such as the "psychokinesis" described by Schmidt could be repeated and so established on a normal scientific basis, then the violation of physical laws, such as the law of causality, that this would imply would pose a serious challenge to the foundations of physics. If tests confirmed that such phenomena exist, physicists would have to face those problems; if not, they could forget them completely.

Not all of the five hundred physicists who attended the three hour session supported Horowitz's proposed tests. Mike Casper, chairman of the Physics Department at Carlton College, Minnesota and a former chairman of the forum on physics and the society, objected to the linking by Horowitz of the proposed tests with the forum, without consultation with the members. He felt that Schmidt's experiments were not sufficiently well designed to distinguish results that confirmed the presence of an effect, from those that ruled it out. He is not against such experiments if they are done responsibly, although he thinks there are more important things the forum could be doing.

The history of deception and self-deception in the study of paranormal phenomena was pointed out by Ray Hyman, once a professional magician and now a professor of psychology at the University of Washington at Eugene. He said that on many occasions the subject seemed to have found a classic experiment that proved beyond doubt that unexplained phenomena of the "mind over matter" type existed, but that each time the results had to be discarded either because of cheating, or because the results could not be repeated. While expressing respect for the quality and thoroughness of some experimenters, including Helmut Schmidt, he doubted that a psychological effect was responsible; he said that the effects observed were much weaker than those normally confirmed using statistics, and that quite different factors might be responsible.

Schmidt emphasised several times during his account of his work that initial screenings of the subjects to pick out the good performers, and the motivation and encouragement generated by the experimenter, were both important factors in getting significant results. Both Hyman and Horowitz accepted that Schmidt's experiments were scientific, in the sense that the equipment was standardised and the same procedure was carried out each time, but Horowitz said that he had been surprised and rather upset by the emphasis that Schmidt had put on the personal and motivational factor. ☐

Physics leading the blind

A stirring call for physicists to harness physical phenomena and modern technology in order to meet the needs of the disabled came from Rosalyn Yalow, who took a share in the 1978 Nobel prize for physiology and medicine, for her work in the development and use of the technique radio-immunoassay.

"People are asking," she said, "why in an age when we can put a man on the Moon, we cannot cure cancer or diabetes. While for these we have to wait for breakthroughs in scientific knowledge, we can apply what we already know to help the blind to see, the deaf to hear, and amputees and those with spinal injuries to have full control of their natural or artificial limbs."

Yalow pointed out that each of these processes is concerned with the transfer of information, and that we are in the middle of a revolution in this field. The blind can read with their fingers, but it is now time to enable them to scan ordinary books and newspapers by converting the printed word, perhaps to sound, and so truly open up the written word to the blind. The technology is feasible—science should make the price right.

"We must make more dynamic use of the technology of the space age, such as microprocessors and micro energy sources, to restore as best we can parts of man's resources," she continued. "I would like to believe that physicists will once again lead the way in converting physical phenomena into the technically feasible."

Yalow, who joined Bronx Veterans Administration Hospital in 1947 after completing a doctorate in nuclear physics, described her researches using radioisotopes in biomedical investigations and the many applications of radio-immunoassay. This technique, which she developed with Solomon Berson, a physician, is used for detecting and measuring very small concentrations of biological substances.

Radio-immunoassay is already routinely used in the diagnosis of underactive thyroids in newborn babies. This condition affects one child in five thousand and can cause irreversible mental retardation if it is not treated promptly. However, a one dollar test on a drop of blood taken from a heel-prick, can indicate an underactive thyroid. Treated children have intelligence quotients equal to those of their siblings. Radio-immunoassay is also the preferred method for testing donated blood and potential blood donors for transfusion hepatitis.

Yalow said that a major factor in the success of her collaboration with Berson, who died in 1972, was that they learned to talk the same hybrid language by educating each other in their own subjects. "I believe maximum effectiveness is achieved when each member of an interdisciplinary team makes a commitment to at least on the job training in the discipline of the others." ☐

Threads from the Shroud

The authorities in Turin have recently given permission for new scientific measurements to be made on the Turin Shroud, said to be Christ's burial wrapping (New Scientist, vol 80, p 96). A group of physicists from the University of Rochester, the University of Toronto, and the General Ionex Corporation, have developed a new method of detecting carbon-14, which they intend to use to date the Shroud.

Carbon-14, which is present in all biological systems, decays with a half-life of 5730 years. Artifacts can be dated by measuring the ratio of carbon-12, which does not decay, to the remaining carbon-14 in the article. One limitation of the method arises because only a small number of decays can be measured in a finite time, due to the long half-life, so sample sizes have to be large for an accurate measurement. This usually means destroying a significant amount of the object—the keepers of the Shroud are naturally anxious to avoid this.

Harry Grove, at the University of Rochester, and colleagues have developed a very sensitive mass spectrometer technique, using the tandem Van de Graaf accelerator there. Their work represents a significant advance over previous attempts at measuring carbon-14 using mass spectrometry, which have been foiled due to the presence of nitrogen and other mass 14 atoms in the material.

The Rochester group has shown that samples containing only 1 mg, or less, of carbon are required, which represents a 1000-fold improvement over traditional techniques. The dating of the Shroud, which is normally locked up, will be made using threads from samples taken in 1973, as soon as another group is in a position to make an independant radiocarbon measurement. ☐

Monitor

Einstein right again

How apt that the year of Einstein's centenary should see the publication of the first qualitatively new observation for six decades to test his general theory of relativity. J. H. Taylor, L. A. Fowler and P. M. McCulloch, of the University of Massachusetts, confirmed Einstein by looking at a weird astronomical object called a binary pulsar, discovered in 1974.

Pulsar PSR 1913+16 is thought to be a rapidly rotating neutron star orbiting another neutron star or black hole, and you observe it by monitoring its extremely rapid and regular radio pulses. The two objects are enormously dense and close to each other, so gravitational effects are thousands of times stronger than in the Solar System. Previous tests of general relativity, restricted to the Solar System, have only with difficulty confirmed even the simplest corrections to Newtonian gravity. Mercury's orbit, for example, is out by a mere 43 seconds of arc per century: contrast the binary pulsar, with 4·2 degrees per year!

Using the pulsar's radio pulses as a precision clock, the three astronomers employed the giant Arecibo radio telescope to measure a variety of interwoven effects that result from Einstein's predicted action of gravity on clock rates. The information content of these accurate observations, now accumulated over four years, is so high that even allowing for fixing parameters of the model, such as the pulsar mass, the internal consistency of general relativity theory can be checked.

It turns out that Einstein was correct, in a most dramatic way. The observations seem to show a steady drift in the orbital period, indicating that the binary is losing energy and spiralling inwards. One obvious cause of such energy depletion has been predicted by general relativity for many years: gravitational radiation. The system acts like a powerful transmitter of gravity waves.

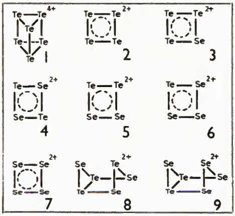
Most relativists will be elated by the new results, which further squeeze alternative theories of gravity. Sceptics will point out that the observations only check the internal consistency of relativity and that the presence of gravitational radiation is merely an indirect inference. Certainly, we must give close scrutiny to the accuracy of the power loss formula. Nevertheless, backing Einstein is usually a safe bet, and further observations in the coming years should tighten these results still further (*Nature*, vol 277, p 437). ☐

Coloured compound cations

A team of chemists has recently solved a 150-year-old mystery. Gary Schrobilgen of Guelph University, Robert Barns of McMaster University and Pierre Granger of IUT de Rouen, knew that elemental selenium and tellurium in oleum formed yellow-green and red-violet solutions respectively: what they didn't know was the nature of the molecular species.

Fortunately, selenium and tellurium possess naturally abundant isotopes with a nuclear spin of $^1{}_2$; selenium contains 7·5 per cent of the isotope ^{77}Se and tellurium has 7·03 per cent of ^{125}Te and 0·89 per cent of ^{123}Te. The researchers could therefore use the technique of nuclear magnetic resonance to study oleum solutions of the two elements separately and also an equimolar mixture. All samples were isotopically enriched with the appropriate spin $^1{}_2$ nuclei (*JCS Chemical Communications*, vol 1978, p 957).

A fascinating variety of cations seemingly exists in these solutions; some have quite curious oxidation states. (The oxidation state of a cation indicates how many electrons must be added to give a normal atom, eg, +2 for Mg^{2+}). The Te_6^{4+} ion (1) is the only known example of a $+^2{}_3$ oxidation state and the mixed complexes $Te_3Se_3^{2+}$ (8) and $Te_2Se_4^{2+}$ (9) have $+^1{}_3$ oxidation states. These last two ions are considered by the chemists as particularly important because it is only through these that the mixed square planar cations (3 6 incl), such as $Te_2Se_2^{2+}$ which has a $+^1{}_2$ oxidation state, can result. ☐



Some of the ionic species

Helping jackals succeed

Results from a long-term field study show that jackals understand evolutionary biology. Pups who stay with their parents to help raise the next litter do better than those who set off to breed themselves, according to Patricia Moehlman of the University of Wisconsin, who studies jackals near Lake Ndutu in Tanzania (*Nature*, vol 277, p 382).

Blackbacked jackals are rare among mammals in that they mate for life, and the adults share many of the duties of parenthood. The two jackals also hunt cooperatively and defend the territory together, although in border disputes with neighbouring pairs aggression is between animals of the same sex. Furthermore, pups from one litter often stay with their parents and assist with the job of rearing the next.

Blackbacked jackals feeding together

Ardea

Moehlman watched a total of 15 litters, and noted that 11 of these had helpers, grown-up pups from the previous litter. The helpers assist the parents in all sorts of ways. They regurgitate for the female while she is still nursing the pups, and when the pups have been weaned help protect them from hyenas and other predators who could easily make a meal of undefended pups.

So what do the helpers get out of their unselfish behaviour? The answer, as predicted by evolutionary biology, ought to be greater reproductive success. Moehlman counted how many pups in each litter survived to 14 weeks (by which time they are more or less safe and independent) and related pup survival to the number of helpers. She found a clear effect, with each helper adding an average of 1·5 pups to the litter.

Because the parents are monogamous, the helpers are assisting their full siblings, to whom they are as closely related as they would be to their own pups. As a result, natural selection favours helpers, but there is no hint of a single gene that turns an ordinary jackal into a helper. Sometimes a pair manage to hold onto some helpers, but in other seasons the pups go off and breed themselves. They are, of course, wrong to do so, because an adult helper gains more (yield one pup per adult) by helping its parents than it would by finding a mate and raising its own pups without help (yield $^1{}_2$ pup per adult). Why pups don't stay and help at least one litter is the next question to answer. ☐

Virus resists interferon

A virus that infects sheep is resistant to interferon, according to D. Carroll of the San Francisco Veterans Administration Hospital. Interferon is a non-toxic, anti-viral substance produced by cells in response to viral infection. Indeed it could be therapeutically as important in the suppression of viral infections as penicillin is in bacterial infections. This makes the report that Visna virus is resistant to high concentrations of interferon even more startling (*Journal of Infectious Disease*, vol 138, p 614).

Visna virus causes an extremely slow degenerative disease of the nervous tissue in sheep. The first sign is an abnormal gait several months after infection. Between this stage and complete paralysis anything up to several years may elapse. The animals remain fully conscious throughout but the disease is invariably fatal. A central issue in understanding chronic viral infections is how a virus like Visna can persist in an animal for so long and how it evades the host defence mechanisms.

Like the RNA C-type tumour viruses, when Visna infects an animal cell the genetic information in its RNA genome is completely transferred, by a specific enzyme, to a DNA intermediate called a provirus, which associates with the animal genes. Although this may look like a mechanism for persistence, later stages in the Visna life cycle are blocked. It does not mature and is not released to infect other cells. It therefore becomes a latent infection because somehow the expression of genes is restricted. Carroll set out to establish whether this restriction was due to interferon.

He assessed virus infectivity by a plaque assay, in which the spread of virus from initially infected cells, in a dish, is restricted so that only adjacent cells become infected. This small area of dead cells shows pale in a deep-staining lawn of healthy cells.

Carroll found that the growth of the Visna virus was uninhibited even at the highest concentrations of interferon that would leave the cells themselves healthy. To obviate the possibility that the interferon decayed during growth of the plaque (which requires two weeks), he pretreated sheep cells with interferon and then monitored a single cycle of viral growth. He found that neither growth nor yield of virus was reduced. Even adding interferon during the later stages of infection, when it may act more efficiently, failed to inhibit the virus. In fact the Visna virus has a striking resistance to levels of interferon that vastly exceed the amount required to inhibit the relatively resistant Herpes simplex virus.

So, in sharp contrast to other RNA viruses responsible for leukaemia and solid tumours in animals, Visna replication is not blocked by interferon. The reason for this difference in susceptibility is unknown but Visna virus has successfully adapted to a prolonged parasitic life in a hostile host and the mechanism of its persistence remains elusive. ☐

Comet West goes west

Comet West, the brilliant comet of 1976, was racked by a sequence of at least five violent events as it passed within 30 million kilometres of the Sun three years ago. New methods of analysing the movements of the debris produced show that a series of brief but massive outbursts of gas and dust accompanied the breakup of the large icy nucleus into at least four fragments. Only two other comets have ever split into as many pieces, and only four in the past 120 years have shown such clearly defined dust bands in their tails.

Computer enhancement of yellow light photographs of the tail of comet West shows five prominent narrow bands. Zdenek Sekanina and J. A. Farrell of the Harvard-Smithsonian Center for Astrophysics and the Los Alamos Scientific Laboratory were able to follow the motion of the dust particles under the influence of solar attraction, radiation pressure and cometary gas outflow. They concluded that each band originated in a single outburst of dust lasting at most an hour or so (*Astronomical Journal*, vol 83, p 1675).

A second study, by Zdenek Sekanina alone, follows the motions of the separating fragments of the comet nucleus (*Icarus*, vol 33, p 173). He found that some of the splitting events not only occurred at the time of dust bursts but some were also accompanied by sudden flares in the comet's overall brightness caused by gas bursts. For example, the initial splitting of the nucleus into two on 19 February 1976 produced a huge cloud of dust which formed the brightest dust band. The comet became brighter within hours as gas also poured off.

More subdued breakup of the nucleus and dust and gas flares have been observed in many comets, but events as violent as those affecting comet West have never been recorded in such detail. The disruptions probably occur when a compacted dust-rich surface bakes hard and traps more volatile materials below. Pressure builds within the comet's head and the surface eventually ruptures in spectacular fashion.

Comet West was a classic example of a fragile new comet rich in volatiles making its first close approach to the Sun. The four fragments now receding into deep space will each return in about a million years time at intervals of a few centuries. But when they do return they will be pale shadows of their parent body after their rough handling by the Sun in February 1976. ☐

Sun and sand can fix nitrogen

Desert sand catalyses the conversion of atmospheric nitrogen into ammonia under the impact of sunlight. Dr Gerhard Schrauzer of the University of California at San Diego told a recent meeting of the American Chemical Society in Savannah, Georgia, that his results suggested that an acre of sandy desert could produce from 1 to 10 kg of ammonia a year. The 6·8 billion acres of this type of desert worldwide could therefore produce 7·5 to 75 million tons of ammonia annually. These new results lead to drastic revision of estimates of the sources and balance of ammonia in the atmosphere. Man-made ammonia clearly makes up a much smaller proportion than previously thought with fixation, by microbes and now, it seems, by sand, playing a major role.

Schrauzer believes that this photochemical reaction is important for ammonia production on Mars and other planets and suggests that one day the reaction may be harnessed industrially in desert areas. He finds that a one per cent fraction of natural sand rich in titanium dioxide and iron accounts for 60-80 per cent of the nitrogen fixing activity. This appears to be a direct natural equivalent of iron-doped titanium dioxide acting as a catalyst of similar photochemical reactions in the laboratory. A solar cell utilising this catalyst and producing 50-100 kg of ammonia per acre per year has already been built, but the yield is too low for practical industrial use. Future processes would probably involve the use of beds of catalyst fed with warm moist air and concentrated sunlight collected by mirrors. The ammonia produced could be absorbed *in situ* into phosphoric acid to give ammonium phosphate fertilisers. ☐

Technology

Britain set for a plastic bottle binge

Bad news for anti-litter groups—Britain is poised to play host to a new wave of plastic bottles for soft drinks and beer. Such bottles first emerged in the US two or three years ago. But now they will begin to appear in increasing numbers in British shops and supermarkets—and no doubt in pleasant parts of the countryside after people have finished with them. By the end of the year, the UK market for plastic beverage bottles will be an estimated 120 million annually. (At present it is 10-20 million.)

The surge in plastic bottle making is explained by new developments in plastics technology. Previously plastic has been useful only as a container for household goods such as detergents—or for drinks, such as milk, which have to be consumed quickly. Until recently it was not economic to produce plastic bottles that could both keep in the "fizz" of carbonated drinks—these include keg beers—and keep oxygen out. Established plastics such as polyvinyl chloride (PVC) are too permeable. But newer polymers, such as polyacrylonitrile and polyethylene terephthalate (PET), can meet the specifications. Processes are now available which can make plastic bottles out of such materials fairly cheaply.

Britain is the biggest market in Europe for the new bottles. This is partly because there is little legislation to stop manufacturers from packing their products in new materials which, in some countries, are considered toxic. For instance, although PET is permitted for drinks bottles in the US, polyacrylonitrile is not. British manufacturers can use either, subject to control of migration of possibly hazardous substances.

Also, Britain has no anti-litter legislation to prevent manufacturers introducing new packaging which has huge potential for creating rubbish. By contrast, disposable containers in Germany are restricted to a fixed percentage of the total packages in circulation. In France, the wine industry has recently decided on keeping bottles returnable as evidence of the strong feeling against disposable bottles.

In the vanguard of the European trend towards plastic bottles is Coca-Cola. Last year the firm test-marketed 1·5 litre sizes of its famous product in Scotland and parts of England. The firm concluded that the market is "very promising", and is launching the new size on a large scale. A much smaller producer, Wells Soft Drinks, of Somerset, has also tested 1·5 litre bottles. The company is exceptional because it has installed its own bottle making machinery. (Bottlers normally buy in from dedicated bottle suppliers.)

Most of the bottles in the UK trials have been imported from either the Swedish PLM Group in Holland or from Carnaud Total Interplastic in France. But in the past few months, a number of UK manufacturers have announced new plastic bottle making plants. These include Metal Box, Fibrenyle and Lin-Pac. The firms will sell the bottles initially to soft drinks firms, though keg-beer breweries could soon follow. (Plastic bottles are not suitable for real ale.)

One of the new moulding machines for plastic drinks bottles—and (below) the finished products, which could soon be a big litter problem

What is so special about the new technology? Basically it lies in a combination of injection moulding and blow moulding in the manufacturing process, plus extremely high accuracy. A plastic bottle is made in much the same way as a glass one. A hot tube of the chosen plastic material is extended, enclosed in a mould, and inflated to give the right form. The success of this operation depends on the polymer's ability to retain its shape at temperatures near its melting point, which is where the moulding takes place.

The newer polymers have a sharp transition between the solid and melting phases. So very accurate temperature control is needed. Fortunately this is possible with modern solid-state monitoring methods, and a better understanding of plastic behaviour. An added complication is that with the new materials, extra accuracy is also needed in specifying the bottle's dimensions. This applies specially to the neck where the seal is made with the cap. Conventional blow moulding cannot produce this accuracy—so a mixture of this and injection moulding is used.

The detailed configuration of the neck and screw threads is moulded by injection, incorporating a "plug" of material which can then be blow-moulded to shape the body of the container. Further sophistications include "orientation" techniques, with which operators control and align the molecular structure of the material to help in the moulding process.

In the newest machines all the operations are carried out in either one or two stages. The two-stage process is the faster and looks particularly promising. This is because a bottle manufacturer can carry out the first stage, leaving the bottler to complete the process on his premises. An injection moulded preform (looking something like a test tube) is produced first: it is then taken away, re-heated, and blown on a site that could be miles away.

Manufacturers all over the world have shown interest in the new processes. In the US—where plastic drinks bottles originated—Coca-Cola, Pepsi and 7-Up have led the way. The main US supplier of the new machinery is Cincinnati-Milacron which has sold at least 145 plants worldwide, though according to reports none so far in Europe. In Europe, PLM and Carnaud have developed their own technology—so have Solvay and Unilever's 4-P Group. Sidel of France should have its own machinery design within a year: and the Japanese firm Nissei has demonstrated a "one-stage" bottle making machine. ☐

Copping it from lead

The American gun firm Smith and Wesson is making bullets wrapped in nylon. This is not to keep them warm, but to cut down on a novel form of lead poisoning. Research has shown that policemen suffer from headaches and dizziness after prolonged firing practice—this is because of the lead their weapons release into the atmosphere.

The innovation ensures lead particles cannot escape after the bullet has lodged in its target. New York's Mount Sinai School of Medicine has tested the new bullets, and found they cut lead emissions from pistols by 70 to 80 per cent. The school previously came up with some alarming results which indicated that, if the British TV image of US policemen as aggressive half-wits is true, then lead poisoning could be at least partially to blame. More than half of 81 policemen tested in New York had high levels of lead in their blood after target practice.

The atmospheric lead causes headaches, dizzy spells, insomnia and irritability. Loss of weight and stomach problems were also reported by a fifth of the policemen tested. And out of the 16 firearms instructors examined, five had "clear biochemical lead-induced abnormalities", says the school. ☐

Why bigger micros are better

Microprocessors are getting bigger. To be precise, eight bits bigger, with the arrival of the first "true 16-bit" micros from rival US semiconductor firms Intel and Zilog. The new devices will be attractive to new types of chip customer—particularly makers of word processors and control equipment.

There are two areas in which having a 16-bit rather than an 8-bit processing unit is a significant advantage. One is where the computer on a chip encodes the letters of the alphabet; the other is where the computer's speed of arithmetic computation is important. To illustrate the difference, engineers from Zilog, which has just announced its ultra-sophisticated Z8000 micro, point to the needs of word processing machinery. This is equipment that carries out automatic typing, computer-controlled editing, and message transmission.

On the face of it, a word processor should find an 8-bit micro ideal. This is because each unit of data held in the micro's memory is a code of eight binary digits—the code gives 2^8, or 256, possible letters. This is an apparently comfortable overlap with the alphabet, and even twice the internationally accepted 7-bit "Ascii" computer code of 128 characters.

A closer look at word processing however shows that users need a large number of character "descriptors". These include specifications for typeface, type-size, colour, print justification, spacing, "video flashing" features, and other, more esoteric, special cases such as characters that must not be printed (passwords on a security system for instance).

Theoretically, operators can use one data item as the character code, and the next as a descriptor. But this is unsatisfactory. There is no way to be sure whether a data item represents a character code or descriptor. A 16-bit micro improves matters considerably. With a 16-bit data item, there is room for 256 descriptor codes—more than enough.

Arithmetic speed becomes critical in control. For instance, automotive engine control, where electronics is used for ignition timing, requires optimisation of many input variables which change at high speed. At the same time, the engine's rotation must be constantly measured to a fraction of a degree. An 8-bit device could easily manage "eight-bit" accuracy, with an error of 1 in 256. But this would not be good enough. A 16-bit accuracy could be achieved by manipulating adjacent data items. But it would take so much longer that the results would arrive too late to be of value. In control, bigness becomes better. Zilog has given its big micro the ability to multiply data items of not just 16, but 32, binary bits, reckoning that this ability will be crucial in control applications.

Most users of the new generation of micros will find the fact that they are "16-bit" less important than the devices' ability to store vast amounts of data and program. The old, so called 8-bit micros (such as the Intel 8080 and its competitors), have an 8-bit data code. But they control 16-bits worth of memory (2^{16} or 65 536 data items). And in the same way, the memory capabilities of the new micros are many times larger again. Zilog's new machine controls over eight million memory items.

This should mean much easier software development. Operators will be able to take advantage of the greater efficiency of these modern chips to produce less efficient programs—that is, quicker to write, but clumsier to run—which still run faster than their old efforts on the old machines.

No-one should think making micros is not a problem. Devising the design by itself is not enough. The problems of putting the much more complicated circuitry of these modern micros onto the tight surface area ("real estate") of a silicon chip have proved greater than Zilog thought. Delays have resulted.

Intel, with its comparable 16-bit micro called the 8086, has a lead in the market of six to nine months. That is more than enough to mean Intel will keep its numbe one position in the fast-moving micro race for an appreciable time to come. □

Diamonds could be office managers' friends

The up-and-coming UK word processing firm, Data Recall, is trying to expand its share of the burgeoning office equipment market. It will soon announce an improved version of its basic product—the "Diamond" screen processor. The Dorking-based firm received a setback a fortnight ago with the establishment of Nexos, the National Enterprise Board's new subsidiary in the office equipment market (*New Scientist*, 1 February, p 300). Nexos-backed by £40 million of government money—will sell the products of another firm, Logica, which is Data Recall's major British rival in the word processing business.

But the Surrey company is later this month expanding its R&D section into a new office block in Dorking. The number of people working in the section will be increased from 21 to 30 over the next few months. Backed by a £250 000 cash injection from merchant bankers Kleinwort Benson, the firm is shortly to announce improvements—mainly in software—which will extend the capabilities of the Diamond machine. Developments will include an improved range of editing carried out on the machine's TV-type screen; a bigger text storage capacity (memory will be doubled from the existing 32 000 bytes); and a new portable power unit. Data Recall's turnover last year doubled from the previous year's level of £600 000. The company is thought to have about 15 per cent of the UK word processing market from "stand-alone" machines. Such units contain their own software, whereas the more expensive "shared logic" machines work from a central software bank. Logica, although well established in the "shared logic" field—where it has about half the UK market—is just entering the single unit field. The latter is currently dominated by non-UK firms such as IBM and the Canadian AES-Wordplex. The UK market for word-processing is expanding at 10-20 per cent annually. □

Riding on air

The latest winter sport for West Germans is tobogganing with inflatable structures that look rather like air beds. The new "sledges"—called Jumbos—are made from PVC-coated polyester fabric which is exceptionally resistant to wear. The German firm Enka, which makes the fabric, says 300 Jumbos were tested without one of them being punctured. The delta-shaped sledge has a series of grooves running underneath. The rider "steers" his structure with either the boot or the hand. Besides the sledges proving safer than the conventional hard wooden ones on account of their softness, Enka says they are much more comfortable. Sitting on an airbed while gliding over the snow is good insulation against cold. □

British coal by wire can save French oil

The 2000 MW power cable under the Channel between Folkestone and Sangatte in France—on which construction is due to start later this year—could result in Britain exporting up to a million tonnes of coal equivalent a year by wire. The connection should also save France from importing 500 000 tonnes of oil, at least until the ambitious French nuclear power programme comes on stream. Yet the £260 million cross-Channel link, agreed by President Giscard and Prime Minister Callaghan as a prestige project, should do more than just provide a painless route for reviving British coal exports to Europe. Already the plans for the link have stimulated talks between Britain and other European countries about further possible undersea connections using similar technology.

The link, with the capacity of a large power station, will provide extra security both for Britain's Central Electricity Generating Board and for Electricité de France. EdF would certainly have valued such a high capacity reinforcement when parts of France were plunged into darkness in December after the breakdown of a high voltage link between West Germany and Paris. The UK and French governments only agreed to the electricity utilities' plans on condition that the connection was commercially viable. This condition should be fulfilled because peak electricity loads of the two countries do not quite coincide. (French workers tend to start and finish earlier than their UK equivalents.) So there should be opportunity for regular and profitable exchange of large blocks of power. The link's first 1000 MW stage should be operational in 1982 and the second in 1983.

The link will supplement the 160 MW connection laid on the Channel seabed in the early 1960s. This has proved vulnerable to shipping and its capacity has been outstripped by demand. Nevertheless, the link proved its worth in the severe winter of 1962-63 when the French helped to supply a badly-frozen UK grid, and again during the long hot summer of 1976. The CEGB then topped up capacity lost by France's drought-stricken hydroelectric stations.

The connection will essentially be four pairs of cables laid in four separate trenches, each some 1·5 metres deep. The eight cables, 46 km long, will be installed in the chalky seabed using an underwater excavator and cable handling machinery developed from tests in the Channel and the Mediterranean. The trenches may be as much as 1000 m apart to minimise possible damage from ships, and trawls and anchors.

The high voltage direct current (HVDC) system of electricity transmission that is being employed in the link is more economical in cable than AC transmission. This is because less copper is needed as the power being carried is less. But a HVDC system needs conversion stations at either end of the link to turn the DC current into the AC form required for the two countries' national grids. The converter valves are stacks of air-cooled thyristors, more reliable than the larger mercury arc valves on the existing link. Full DC power is instantly controllable by modern switching techniques. These enable big blocks of power to be switched on, or even reversed, in seconds.

"CE N'EST PAS LUMIERE C'EST 'LIGHT'"

British and French planners have been encouraged by the successful operation of the largest undersea power link in the world—the 130 km 250 kV DC twin power cable link under the Skagerrak between Norway and Denmark. Norway's hydroelectric stations regularly help out during Denmark's morning and evening peaks, while at night and weekends oil-fired stations in Denmark provide Norway with off-peak power.

Such is the promise of undersea cable links, and the switching flexibility of thyristor converters, that the CEGB is talking about another European link. This would be with Belgium; it would provide Britain with another "plug" into the European electricity system, nearer to its industrial centre of gravity than northern France. And not to be left out of the advantages of joining an internationally connected system, talks are underway concerning a link between Wales and Eire, and for another between oil-dependent Northern Ireland and the abundant capacity of the South of Scotland Electricity Board. ☐

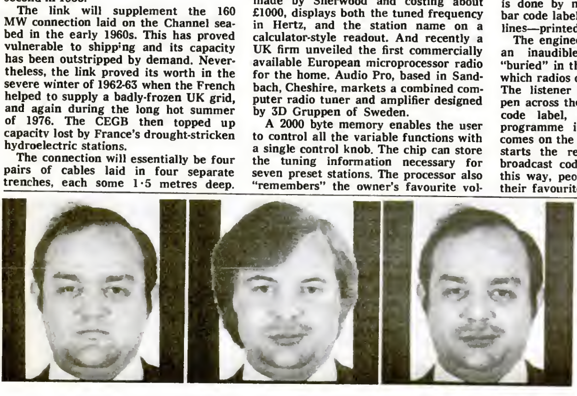
Radios get cleverer

Microprocessor brains are beginning to find their way into radio receivers for the home. In the US, a hi-fi tuner is on sale with a memory which can store the information necessary to tune itself into a score of preset stations. The device, made by Sherwood and costing about £1000, displays both the tuned frequency in Hertz, and the station name on a calculator-style readout. And recently a UK firm unveiled the first commercially available European microprocessor radio for the home. Audio Pro, based in Sandbach, Cheshire, markets a combined computer radio tuner and amplifier designed by 3D Gruppen of Sweden.

A 2000 byte memory enables the user to control all the variable functions with a single control knob. The chip can store the tuning information necessary for seven preset stations. The processor also "remembers" the owner's favourite volume and tone control settings. Future models may be programmed to identify any internal faults as they develop.

Meanwhile, BBC research engineers are developing a receiver which not only displays the frequency and the name of the station being received, but can be tuned in to a selected programme. This is done by moving a light pen over a bar code label—a series of closely spaced lines—printed in the *Radio Times*.

The engineers are experimenting with an inaudible digitally coded signal, "buried" in the programme transmission which radios of the future will recognise. The listener will simply move a light pen across the relevant *Radio Times* bar code label, a few days before the programme in which he is interested comes on the air. When the transmission starts the receiver will recognise the broadcast code and switch itself on. In this way, people need never again miss their favourite programmes. ☐



Playing the face game

The faces on the left all belong to the same person. The man is the subject of an experiment at the Computer Aided Design Centre at Cambridge. The centre has devised equipment, which the Home Office is studying with which a face can be "built up" on a TV screen, just like the police identikit system. ☐

Is the Earth getting bigger?

Some geologists believe that our world is expanding

Dr Robert Muir Wood is a research fellow at Trinity Hall, Cambridge

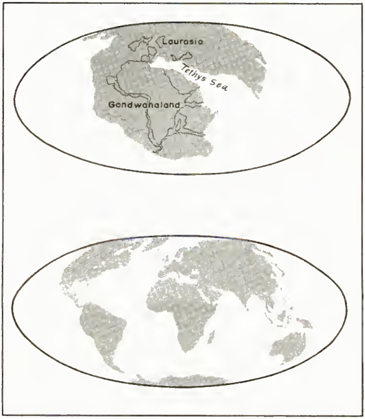
With the idea that when things get sleepy you bring on the magicians and clowns, the Geological Society recently convened to discuss "The expanding Earth theory", or EET. Proposing the notion were a bombastic Tasmanian professor of geology (Warren Carey) and a less flamboyant English geophysicist (Dr Hugh Owen). During the course of a theatrical afternoon they elaborated their case that the Earth had swollen by some 20 per cent in the past 200 million years.

Most evidence for the EET comes from playing at jigsaw puzzles with the drifting continents. "In the beginning," goes the EET argument, "the continents completely covered a smaller Earth. During its recent expansion the more rigid continental crust has become fragmented, separated by expanses of ocean. Rejoining the wandering continents we find they fit better if we contract the size of the globe on which we are trying to fit them."

A quick glance at the ancient super-continent Pangaea, which existed about 250 million years ago, is enough to see that it has "a slice missing". In conventional geological explanations this slice is the former Tethys Ocean. The EET version is that Tethys never existed; the two sides join up for a smaller Earth. The image is neat, but is hardly supported by all the evidence for remnants of the ocean and its influence that are dotted along the mountain range that runs from Spain to China.

Professor Carey's EET holds that oceans can grow in extent but cannot contract—he does not believe in the plate tectonic idea of subduction (the consumption of ocean-crust back down into the upper mantle). The Alpine chain of mountains is not, he maintains, the result of the loss of an intervening ocean but is from shear motions arising from differential moments of inertia between those parts of the Earth that are continental and those parts that are oceanic. Like the atmosphere, the continents tend to lag behind the rotation of the Earth. Thus the southern side of the Alpine mountain belt (that is on the side of the more oceanic, Southern hemisphere) has moved east relative to the north. According to the Professors, former mountain ranges have formed from similar East-West shear zones. There are many pieces of evidence against this: the distribution of fossils; the emplaced fragments of ocean-floor crust. It is, however, fair to say that shear zones and continental cracks like the East African Rift Valley and the North Sea-Rhine rift system are more important than plate-tectonic models would care to admit.

As the exposition continued, Professor Carey even argued that two pieces of accepted data about the Pacific Ocean, that its size has decreased while its perimeter has increased, were irreconcilable; but a simple demonstration can show that once larger than a hemisphere (the approximate size of the Pacific Ocean) the perimeter does decrease while the area increases. The arguments of Dr Owen were entirely concerned with the small scale matching of the edges of continental fragments. Such an approach, for areas such as the Caribbean, is like using a hammer to force reluctant pieces to fit into a jigsaw puzzle.



Above: Pangea, the super-continent, 250 million years ago—note the "missing" slice. Below: the continents as they are today

The opposition to the EET was also articulate. Critics pointed out that: 1) other bodies in the solar system (the Moon, Mars and Mercury) have definitely not undergone conspicuous expansion for the past 4000 million years; and 2) measurements from the magnetic dips of rocks across thousands of kilometres of continent, as well as details obtained from the daily growth patterns of fossil corals, suggest that the Earth has stayed very much the same size for at least the last 500 million years.

Further, one has to have a mechanistic theory before entering the scientific arena. The Earth has expanded because, said Professor Carey, of continuous creation of new matter in the depths of its bowels. Why does new matter not get formed at the surface? Because, says Carey, it is formed only under high temperatures and pressures. Then why not inside Mars?

One is soon back to medieval geocentric mysticism. If, it was pointed out, matter is created under high pressure and temperature, one can experiment, for science is, after all, concerned with experimental verification. If the EET requires that the Earth's radius expands at 5 cm each year, then the magnitudes of spontaneous creation are great enough for us to conduct any number of experiments to demonstrate the phenomena. At this point the chairman interrupted to say that, "This was not geology" (ie cricket), so, instead, discussion returned to the unresolvable vagaries of subjective geological interpretation.

A belief in the expanding Earth theory is reinforced because; 1) we cannot see subduction—because it is destructive; 2) we cannot see past oceans—because in the nature of plate tectonic theories they are destroyed; and 3) our knowledge of the Earth's mantle can only be indirect. All the information that has so far been obtained about the mantle does, however, reinforce the model of plate tectonics being the surface expression of deep level convection.

But perhaps that is missing the point. Such ideas as the expanding Earth, with its biological metaphoric supply from growth and pregnancy, provide entertainment for a cold winter afternoon. ☐

Ken Cox

One standard lifespan

During an average life, all mammals have nearly the same number of breaths and heartbeats

Stephen Jay Gould

MEETING with Henry Ford in E. L. Doctorow's *Ragtime*, J. P. Morgan praises the assembly line as a faithful translation of nature's wisdom:

> Has it occurred to you that your assembly line is not merely a stroke of industrial genius but a projection of organic truth? After all, the interchangeability of parts is a rule of nature. . . . All mammals reproduce in the same way and share the same designs of self-nourishment, with digestive and circulatory systems that are recognisably the same, and they enjoy the same senses. . . . Shared design is what allows taxonomists to classify mammals as mammals.

An imperious tycoon should not be met with equivocation; nonetheless, I can only reply "yes, and no" to Morgan's pronouncement. Morgan was wrong if he thought that large mammals are geometric replicas of small ones. Elephants have relatively smaller brains and thicker legs than mice, and these differences record a general rule of mammalian design, not the idiosyncracies of particular animals.

Morgan was right in arguing that large animals are essentially similar to small members of their group. The similarity, however, does not lie in a constant shape. As I have argued before, the basic laws of geometry dictate that animals must change their shape in order to perform the same function at different sizes. I remind readers of the classical example, first discussed by Galileo in 1638: the strength of an animal's leg is a function of its cross-sectional area (length × length); the weight that the leg must support varies as the animal's volume (length × length × length). If a mammal did not alter the relative thickness of its legs as it got larger, it would soon collapse because body weight would increase much faster than the supporting strength of limbs. Instead, large mammals have relatively thicker leg bones than small mammals. To remain the same in function, animals must change their form.

The study of these changes in form is called "scaling theory". Scaling theory has uncovered a remarkable regularity of changing shape over the 25-millionfold range of mammalian weight from shrew to blue whale. If we plot brain weight versus body weight for all mammals on the so-called mouse-to-elephant (or shrew-to-whale) curve, very few species deviate far from a single line expressing the general rule: brain weight increases only two-thirds as fast as body weight as we move from small to large mammals. (We share with bottle-nosed dolphins the honour of greatest deviance from the curve.)

We can often predict these regularities from the physical behaviour of objects. The heart, for example, is a pump. Since all mammalian hearts are similar in function, small hearts will pump considerably faster than large ones (imagine how much faster you could work a finger-sized toy bellows than the giant model that fuels a blacksmith's large forge). On the mouse-to-elephant curve for mammals, the length of a heartbeat increases between one-fourth and one-third as fast as body weight as we move from small to large mammals. The generality of this conclusion has just been affirmed in an interesting study by J. E. Carrel and R. D. Heathcote on the scaling of heart rate in spiders. They used a cool laser beam to illuminate the hearts of resting spiders and drew a crab spider-to-tarantula curve for 18 species spanning nearly a thousandfold range of body weight. Again, scaling is very regular with heart rate increasing four-tenths as fast as body weight or 0·409 times as fast, to be exact.

We may extend this conclusion for hearts to a very general statement about the pact of life in small versus large animals. Small animals tick through life far more rapidly than large ones—their hearts work more quickly, they breathe more frequently, their pulse beats much faster. Most importantly, metabolic rate, the so-called fire of life, scales only three-fourths as fast as body weight in mammals. Large mammals generate much less heat per unit of body weight to keep themselves going. Tiny shrews move frenetically, eating nearly all their waking lives to keep their metabolic fire burning at its maximal rate among mammals; blue whales glide majestically, their hearts beating the slowest rhythm among active, warmblooded creatures.

If we consider the scaling of lifetime among mammals, an intriguing synthesis of these disparate data seems to suggest itself. We have all had enough experience with mammalian pets of various sizes to understand that small mammals tend to live for a shorter time than large ones. In fact, the scaling of mammalian lifetime follows a regular curve at about the same rate as heartbeat and breath time—between one-fourth and one-third as fast as body weight as we move from small to large animals. (Again, *Homo sapiens* emerges as a very peculiar animal. We live far longer than a mammal of our body size should. I have previously argued that humans evolved by a process called "neoteny"—the retention of shapes and growth rates that characterise juvenile stages of our primate ancestors. I also believe that neoteny is responsible for our elevated longevity. Compared with other mammals, all stages of human life—from juvenile features to adulthood—arise "too late." We are born as helpless embryos after a long gestation; we mature late after an extended childhood; we die, if fortune be kind, at ages otherwise reached only by the very largest warmblooded creatures.)

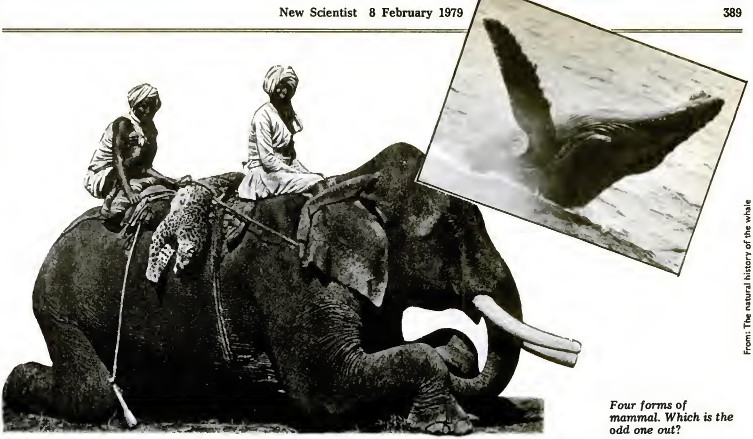
Small or large, time's the same

Usually, we pity the pet mouse or gerbil that lived its full span of a year or two at most. How brief its life, while we endure for the better part of a century. As the main theme of this column, I want to argue that such pity is misplaced (our personal grief, of course, is quite another matter; with this, science does not deal). J. P. Morgan of *Ragtime* was right—small and large mammals are essentially similar. Their lifetimes are scaled to their life's pace, and all endure for approximately the same amount of biological time. Small mammals tick fast, burn rapidly, and live for a short time; large ones live long at a stately pace. Measured by their own internal clocks, mammals of different sizes tend to live for the same amount of time.

Yet we are prevented from grasping this important and comforting concept by a deeply ingrained habit of Western thought. We are trained from earliest memory to regard absolute Newtonian time as the single valid measuring stick in a rational and objective world. We impose our kitchen clock, ticking equably, on all things. We marvel at the quickness of a mouse, express boredom at the torpor of a hippopotamus. Yet each is living at the appropriate pace of its own biological clock.

I do not wish to deny the importance of absolute, astronomical time to organisms. Animals must measure it to lead successful lives. Deer must know when to regrow their antlers, birds when to migrate. Animals track the day-night cycle with their circadian rhythms; jet lag is the price we pay for moving much faster than nature intended. The bamboos somehow count 120

Professor Jay Gould teaches biology, geology and the history of science at Harvard.
© *Natural History*



From: The natural history of the whale

Four forms of mammal. Which is the odd one out?

years before flowering again.

But absolute time is not the appropriate measuring stick for all biological phenomena. Consider the song of the magnificent humpback whale. E. O. Wilson has described the awesome effect of these vocalisations: "The notes are eerie yet beautiful to the human ear. Deep basso groans and almost inaudibly high soprano squeaks alternate with repetitive squeals that suddenly rise or fall in pitch." We do not know the function of these songs. Perhaps they enable whales to find each other and to stay together during their annual transoceanic migrations.

Each whale has its own characteristic song; the highly complex patterns are repeated over and over again with great faithfulness. No scientific fact that I have learned in the last decade struck me with more force than Payne's report that the length of some songs may extend for more than half an hour. I have never been able to memorise the five-minute first *Kyrie* of the *B-minor Mass* (and not for want of trying); how could a whale sing for thirty minutes and then repeat itself accurately? Of what possible use is a thirty-minute repeat cycle—far too long for a human to recognise; we would never grasp it as a single song (without Payne's recording machinery and much study after the fact). But then I remembered the whale's metabolic rate, the enormously slow pace of its life compared with ours. What do we know about a whale's perception of 30 minutes? A humpback may scale the world to its own metabolic rate; its half-hour song may be our minute waltz. From any point of view, the song is spectacular; it is the most elaborate single display so far discovered in any animal. I merely urge the whale's point of view as an appropriate perspective.

We can provide some numerical precision to support the claim that all mammals, on average, live for the same amount of biological time. In a method developed by W. R. Stahl, B. Gunther, and E. Guerra in the late 1950s and early 1960s, we search the mouse-to-elephant equations for biological properties that scale at the same rate against body weight. For example, Gunther and Guerra give the following equations for mammalian breath time and heartbeat time versus body weight.

$$\text{breath time} = 0{\cdot}0000470\ \text{body}^{0.28}$$
$$\text{heartbeat time} = 0{\cdot}0000119\ \text{body}^{0.28}$$

(Non-mathematical readers need not be overwhelmed by the formalism. The equations simply mean that both breath time and heartbeat time increase about 0·28 times as fast as body weight as we move from small to large mammals.) If we divide the two equations, body weight cancels out because it is raised to the same power.

$$\frac{\text{breath time}}{\text{heartbeat time}} = \frac{0{\cdot}0000470\ \text{body}^{0.28}}{0{\cdot}0000119\ \text{body}^{0.28}} = 4{\cdot}0$$

This says that the ratio of breath time to heartbeat time is 4·0 in mammals of any body size. In other words, all mammals, whatever their size, breathe once for each four heartbeats. Small animals breathe and beat their hearts faster than large animals, but both breath and heart slow up at the same relative rate as mammals get larger.

Lifetime also scales at the same rate to body weight (0·28 times as fast as we move from small to large mammals). This means that the ratio of both breath time and heartbeat time to lifetime is also constant over the whole range of mammalian size. When we perform an exercise similar to that above, we find that all mammals, regardless of their size, tend to breathe about 200 million times during their lives (their hearts, therefore, beat about 800 million times). Small mammals breathe fast, but live for a short time. Measured by the sensible internal clocks of their own hearts or the rhythm of their own breathing, all mammals live about the same time. (Astute readers, having counted their breaths, may have calculated that they should have died long ago. But *Homo sapiens* is a markedly deviant mammal in more ways that braininess alone. We live about three times as long as mammals of our body size "should", but we breathe at the "right" rate and thus live to breathe about three times as much as an average mammal of our body size.)

The mayfly lives but a day as an adult. It may, for all I know, experience that day as we live a lifetime. Yet all is not relative in our world, and such a short glimpse of it must invite distortion in interpreting events ticking on longer scales. In a brilliant metaphor, the pre-Darwinian evolutionist Robert Chambers spoke of a mayfly watching the metamorphoosis of a tadpole into a frog (from *Vestiges of the Natural History of Creation, 1844*):

> Suppose that an ephemeron [a mayfly], hovering over a pool for its one April day of life, were capable of observing the fry of the frog in the waters below. In its aged afternoon, having seen no change upon them for such a long time, it would be little qualified to conceive that the external branchiae [gills] of these creatures were to decay, and be replaced by internal lungs, that feet were to be developed, the tail erased, and the animal then to become a denizen of the land.

Human consciousness arose but a minute before midnight on the geologic clock. Yet we mayflies, ignorant perhaps of the messages buried in earth's long history, try to bend an ancient world to our purposes. Let us hope that we are still in the morning of our April day. □

They can control the Sun in Cardiff

A British solar simulator is playing a leading part in European solar research and development and is also providing a test facility to enable the performance and quality of solar heating panels to be checked

Bill Gillett
is with the Solar
Energy Unit of
University College,
Cardiff

More than 70 manufacturers now market solar domestic and swimming pool heaters in the UK, creating an increasingly urgent need for standards and codes of practice to protect the public from inadequately designed and poorly installed systems. Anticipating this growth of interest, scientists in Cardiff began in 1975 to design and construct an indoor test facility which would allow solar collectors to be evaluated under controlled conditions.

The hardware of the simulator was completed in April 1978, construction being prolonged by complications in modifying an original lecture theatre. So far it has been used to test solar panels for research projects of both an international and European nature, and also to develop techniques for calibrating solar test facilities.

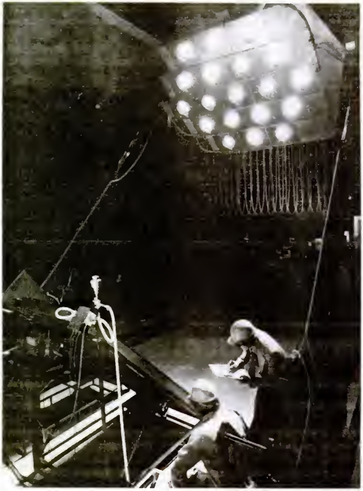
Funding for the facility came initially from the Science Research Council in the form of a grant for two years in 1975, matched by University College to bring the total to over £30 000. The SRC granted a further amount for another two years in October 1978 bringing the total to over £60 000. In addition to continuing development of the basic simulator to improve its specification, this money will also provide for extension of the range of climatic conditions that can be simulated (by adding an air conditioning system), better instrumentation and general upgrading.

Close to the real thing

The artificial sun, or solar simulator, consists of an array of compact source iodide (CSI) lamps which have an output spectrum closely resembling that of natural solar radiation. These were developed by Thorn Lighting for colour television filming and are now widely used in football stadia and other places with outdoor lighting. The light output, in fact, closely resembles the Air Mass 2 solar spectrum, an internationally recognised spectrum for simulating solar radiation at the surface of the Earth.

By using CSI lamps the Cardiff simulator is breaking new ground. Many other artificial suns, such as the one at NASA-Lewis (which recently moved to NASA's Marshall research centre) use tungsten halogen lamps, and these give rise to a number of problems. High temperature types have shorter lives and those used are generally of lower rating than the 1kW CSIs at Cardiff. They also require a compromise between uniformity of beam distribution and other parameters, if their output spectrum is to be representative of the Sun's radiation. Finally by using high power lamps, the Cardiff simulator can locate the array further away from a panel under test to give a particular "solar radiation", going a long way to solving one of the major problems with solar simulators, unwanted infrared radiation.

Following Cardiff's lead other similar simulators are now being built in France, Denmark, Sweden, and Australia. Furthermore, a British simulator has just been announced at Newcastle using 400W CSI's details of which were given in a paper (written by Professor G. R. Bainbridge and J. R. Laidlow of Newcastle University) at last week's "Future Energy Concepts" conference at the IEE. By designing its own reflectors, the Newcastle team hopes to achieve a narrower beam divergence.



Cardiff's "artificial sun" has recently been fitted with a dimming system to allow more realistic simulation of solar radiation. Next, an air conditioning system will allow true climatic conditions to be represented

In Cardiff, the array of 19 1kW lamps can be moved by a series of interlinked hydraulic rams through an arc of 90° to simulate the full range of solar altitude. The capability of varying altitude, azimuth and intensity makes it possible in principle to simulate a full-day's performance on a solar collector anywhere in the world. But in practice it is likely to be more cost effective to make a number of measurements and to deduce from them the performance of a particular collector. The lamps are supported on extendable arms which can be adjusted to provide a variation in intensity at the test surface from 750 W/sq m to 850 W/sq m as a result of the beam divergence (9° to 10 per cent of peak intensity). A further reduction to 350 W/sq m has recently been made possible by installing a 28 kVA variable transformer; this is used instead of semiconductor type controllers as it avoids the spiky current waveforms that can result from such equipment.

The SRC simulator has a test zone 2·25 m in diameter, large enough to permit testing full sized solar collectors at any inclination to the horizontal. (Most work is, however, done on panels at the widely accepted tilt angle of 45°.) Unlike many of its counterparts in the US and elsewhere in Europe, its operators do not need to make allowances, when measuring collector performance, for differences between the true solar spectrum and that of the artificial radiation. The SRC simulator can be used in just the same way as if the collectors were outdoors, with the advantage that the "Sun" is under control.

During the past three years the Solar Energy Unit at Cardiff—with around 20 people, it is the largest such research team in the UK—has been working with engineers and scientists from other countries to develop test procedures for solar collectors. Most of this work forms part of the collaborative research programmes of the European Commission and the International Energy Agency (IEA). The solar simulator has been used to test specimen collectors for both programmes.

Consumer protection

International work is intended to curtail the number of test procedures for analysing solar collector performance both in Europe and world-wide. Originally the National Bureau of Standards in the US published the first formal procedure in 1974. By 1976 the EEC's Joint Research Centre at Ispra, Italy, had produced about seven more. The European solar energy community is now attempting to reduce these to just three—one from the American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE), one from AFNOR the French equivalent of the British Standards Institution (BSI) and the third from the Bundersverband Solar energie in W. Germany. A fourth one now being developed under the aegis of the BSI may eventually be the most suitable for UK conditions. Cardiff's facilities and research team are contributing to the preparation of these procedures.

With consumer protection in mind, the BSI formed a technical committee in May 1977 to draft a Code of Practice for the installation of solar water heating systems and a "method of test" for solar collectors. The draft Code of Practice has been issued for public comments; these have now been received and will be the chief item on the agenda of the BSI Technical Committee when it meets on Friday 9 February (tomorrow).

The UK climate is too variable to permit regular use of the simple steady test procedures which have been adopted in the US; other possibilities must therefore be considered here. Although manufacturers and consumers may well feel that measurements of system performance in real outdoor weather should be made, the availability of an indoor collector performance test is undoubtedly a valuable option. Indeed, it would not be an entirely new departure if the British Standard were to include performance testing under an artificial sun, since the standards in both the US and France already include this possibility.

At present the SRC solar simulator is fully employed in the research programmes of the Cardiff Unit and is being used to study collector design and the influence of the environment on collector performance. It will also be used for studies of other thermal applications of solar energy including solar ponds and swimming pools. However, it will eventually be made available to industry for performance testing of commercial solar collectors during the times when it is not required for research purposes.

Any such initiative is dependent on the Cardiff Solar Energy Unit increasing its manpower and installing additional instrumentation to suit continuous testing of the type that industry would require. At present a proposal is being considered by government departments. Charges that might be levied have not yet been decided but preliminary talks with industry have shown that suggestions of £500 per time (for testing one panel) do not reduce the solar heating industry's desire to get access to the simulator. ☐

Venus questions answered

A first look at data from the Venus Pioneer mission confirms some ideas about the "veiled planet", but may increase speculation on the origin of the Solar System

Eric Burgess
is a freelance writer specialising in space science stories

In December last year the NASA Pioneer Venus mission began to return vast amounts of data to Earth. Five probes penetrated the atmosphere of Venus, while an Orbiter spacecraft began to circle the planet (*New Scientist*, 7 December, p 763). A preliminary analysis of the data has already answered several of the major questions about Venus that were outstanding before the mission. Others may be answered in the coming months as the data from the probes are further analysed and the Orbiter continues to send more information about the planet.

The probes provided a detailed picture of the Venus atmosphere, supplementing information obtained from earlier Soviet spacecraft and also making some new discoveries. At about 1200 km (744 miles) above the surface of the planet the Day Probe crossed the "bow shock", where the atmosphere of Venus holds off the stream of electrons and protons from the Sun known as the solar wind (Figure 1). Venus has little or no planetary magnetic field, but the solar wind induces a field in the planet's ionosphere, which forms a barrier to the solar wind. Instruments carried by the spacecraft measured this strong magnetic field at the top of the ionosphere. The planet's bow shock wave was very strong.

The solar wind confines the ionosphere below a well defined boundary which has been called the ionopause. But some of the energy of the wind penetrates through this boundary and heats the atmosphere to an energy equivalent temperature of 5000 K (8500°F). The spacecraft confirmed that the height of the ionopause varies with changes in the solar wind. During the first week of Orbiter operations at Venus, the speed of the solar wind gradually decreased from 500 to 250 km/s (310 to 155 miles/s) and

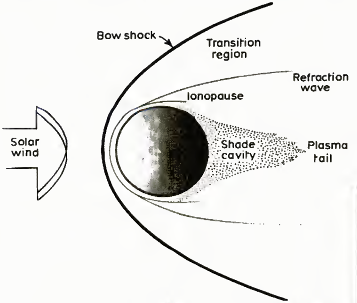


Figure 1 The bow shock, where the solar wind meets Venus

Space Frontiers Ltd.

Above The first view of Venus seen by Pioneer Orbiter. Left Rotation of the Venus atmosphere recorded by Mariner 10

consequently the ionopause gradually rose from 250 to 1500 km (155 to 930 miles). When a solar flare occurred and pushed the speed of the solar wind to 600 km/s (370 miles/s) the ionosphere was crushed toward the planet until the ionopause was only 250 km (155 miles) above the planet's surface. In the region between the "bow shock" and the top of the ionosphere both solar plasma and magnetic field were typically very turbulent and at a temperature of about one million degrees—many times that in the comparable region of the Earth's atmosphere.

The sensible atmosphere of the planet begins at an altitude of 250 km (155 miles) above the surface, where the density is 10^{-15} g/cu.cm. At 125 km the density is 10^{-10} g/cu.cm. Upper atmospheric temperatures measured by the spacecraft were 27°C (80°F) at 250 km (155 miles) and −93°C (−134°F) at 100 km (62 miles). At lower altitudes the temperature increased until it attained about 450°C (840°F) close to the surface.

The structure of the upper atmosphere is dominated by three important heights which were measured by Pioneer for the first time. At 144 km (90 miles) the "turbopause" is the level at which atmospheric gases change from being intimately mixed to being layered gravitationally with the lighter gases occupying upper layers. Within almost 1 km of this height is the region of the Venus ionosphere where the ion density is greatest. In this region the most abundant ion was found to be that of singly charged molecular oxygen (O_2+). Above the layer of maximum ion density and extending to the top of the atmosphere, the most abundant ion was found to be that of singly charged atomic oxygen ($O+$).

The third region measured by Pioneer is called the "exobase". It is the bottom of the "exosphere", the region from which gas molecules can escape into space because they have a very low probability of colliding with a molecule above them. Pioneer measurements place this exobase at 160 km (100 miles). Thus, on Venus, all three boundaries are close together, contrasting markedly with Earth where the turbopause is at 100 km (60 miles), the ion maximum at 200 km (120 miles), and the exobase is at 500 km (350 miles).

Pioneer also found that Venus has an ionosphere on its night hemisphere despite the absence of ionising solar radiation during the long Venus night. This confirmed results from earlier spacecraft, but Pioneer also discovered a possible cause. Its instruments detected the presence of extremely long-lived ions of magnesium and iron which probably originate from meteorites. Such ions could account for this night-time ionosphere.

As the probes descended into the Venus atmosphere they encountered the yellow sulphurous clouds which along with the dense atmosphere reflect 75 per cent of the sunlight away from the planet, making it the bright object in our dawn skies this month. The topmost layer was encountered at about 70 km (43 miles) above the surface. It consists of sulphuric acid droplets about 1 micrometre (μm) in diameter, and it is about 5 km (3 miles) thick. In this layer there are about 300 acid droplets per cu.cm. At the bottom of the layer the Sun can no longer be seen as a disc, but its light penetrates through the layer as through a thin terrestrial fog. Visibility within the layer is fairly good, about 6 km (4 miles). The temperature within the uppermost cloud layer is about 2°C (35°F), and the atmospheric pressure there is about half that at Earth's sea level.

From 58 to 52 km (35 to 32 miles) there is a second layer of clouds distinguished from the first by the presence of a large number of liquid and solid sulphur particles in addition to the sulphuric acid droplets. The liquid sulphur particles are about 4 μm in diameter; the solid particles are about 10 to 15 μm in diameter. The large particles predominate, but there are only about 100 particles per cu.cm in this cloud layer. The temperature is about 40°C (104°F), and visibility is about 1·6 km (1 mile).

Below the second layer there is a brief clear space followed by a third layer extending from 52 to 49 km (32 to 30 miles) above the surface. This layer has 400 particles per cu.cm, most of which are large particles of sulphur. Temperature within the layer is about 80°C (176°F), and the pressure equals that at Earth's sea level. While the upper two cloud layers are more like hazes, the third layer approaches a cloud density similar to clouds on Earth.

Beneath the lowest cloud layer there is some slight haze, the composition of which has not yet been determined. Below about 32 km (20 miles) the atmosphere is comparatively clear and visibility extends to 80 km (50 miles) with a general illumination comparable with that on a bright but cloudy terrestrial day. But as the probes went deeper the light became redder and visibility was reduced by scattering within the dense atmosphere, probably from dust particles. At 10 km (6 miles) above the surface the illumination was quite red and horizontal visibility was restricted to 12 km (7 miles). At about 7 km (4 miles) an observer on the probe would have been able to make out some surface features in the red murk below. At the surface, however, general illumination is a lurid red with horizontal visibility about 3 km (1·8 miles). From the surface it is not possible to tell where the Sun is located in the sky.

Sulphuric acid droplets, together with liquid and solid sulphur particles probably rain from the clouds to form an atmospheric chemical soup at lower levels. This consists of water vapour, sulphur dioxide and oxygen. The mixture circulates into the higher atmosphere where it is acted on by incoming solar ultraviolet radiation to reform cloud droplets of sulphuric acid and cloud particles of sulphur. The discovery of free oxygen in the lower atmosphere, and its absence above the clouds, suggests very vigorous oxidising reactions within the cloud layers so that they effectively prevent any free oxygen from rising above them. Also Pioneer discovered that elemental sulphur is not present at altitudes above 58 km (36 miles), that is, in the topmost cloud layer.

Measurements by Pioneer show that the atmosphere as a whole consists of 98 per cent carbon dioxide, 1 to 3 per cent nitrogen, with a few parts per million (ppm) of helium, neon and argon. Although the amounts of neon and argon are small, they show that there is 500 times as much primordial argon and 2700 times as much primordial neon as in the terrestrial atmosphere. Most theories of the origin of the Solar System have the Sun and the planets forming at the same time. The terrestrial planets, Mercury, Venus, Earth, and Mars, are believed to be small and rocky because the Sun relieved them of their light constituents, but the other planets, being further away did not lose their light gases. However, if the inner planets did experience such a loss, we would expect the amounts of argon and neon in planetary atmospheres to be less on those planets closer to the Sun. Instead, the space probes have shown that this is not true.

The explanation may be that originally the entire gas cloud which later formed the Sun and the planets was evenly heated. As a result, the concentrations of heavier gases would increase toward the Sun because of the gravitational field effects of the primordial gas cloud. These gases would be expected to adhere to dust grains of the gas cloud and later become incorporated inside the planets before the Sun heated up and could drive them away. Lighter elements than the rare gases would not have condensed and been collected by the planets as quickly as the rare gases, and would consequently have been stripped from the inner solar system by the ignited Sun, as is observed today. But the measured concentrations of primordial argon and neon seem to imply that the bulk of the planets formed before the Sun's nuclear fires began.

Primordial water lost

From the Pioneer results it has been ascertained that the atmosphere of Venus contains about the same amount of nitrogen as does the Earth's atmosphere. The two planets also have almost equal amounts of carbon dioxide, but most of the terrestrial carbon dioxide is locked in carbonate rocks. The discovery below the clouds of 0·1 to 0·4 per cent water vapour and 60 ppm of free oxygen strengthens the speculation that Venus initially had abundant water and lost it. Scientists now think that the water on Venus—in contrast to that on Earth and Mars—was able to circulate high in the atmosphere of the planet where it was dissociated by solar ultraviolet radiation. The hydrogen escaped into space from the exosphere and the oxygen was trapped in the surface rocks. If Venus does have a terrestrial-type geology, as the early Pioneer results suggest, many of the surface rocks may have been cycled in crustal folding and other movements during the several billion years since the crust formed on the planet. This would provide ample time for nearly all the oxygen to combine with the rocks in reactions such as conversion of ferrous to ferric iron. Only a very small amount of hydrogen escapes from the planet today, as measured by the Pioneer spacecraft's instruments, implying that the process of water loss is now virtually completed.

Temperature profiles of the Venus atmosphere obtained from Pioneer suggest large-scale global flow patterns as was suggested by the Mariner 10 ultraviolet light pictures obtained several years ago. It appears from the new data that the lower atmosphere is turning over convectively up to an altitude of about 10 km (6 miles). Temperature differences at different altitudes within the cloud layers indicate relatively small-scale convective disturbances there also. In between the layers the atmosphere seems convectively stable, driven by large-scale weather circulation.

The cloud tops are found to be 1-2°C cooler on the day side than on the night side of the planet. This is thought to be because the clouds are higher on the day side. The atmosphere above the clouds in the region of 60 to 100 km (37 to 62 miles) above the surface is also a few degrees warmer due to solar heating. The fact that the temperature difference betwen day and night is so small implies that the winds circling the planet in the high atmosphere distribute heat very effectively.

Infrared radiometer measurements over the polar regions confirmed a downward-moving polar vortex developing above 70° latitude. The vortex indicates that the planet has a large-scale atmospheric pattern, as had been expected from Mariner 10 pictures, with atmosphere rising as a result of equatorial heating and then descending at the poles. Surprisingly, the layer of atmosphere extending to 40 km (25 miles) above the polar clouds is 10°C (18°F) hotter than the same region of air over the equator. This contradicts findings from earlier spacecraft that the poles were 10°C cooler than the equator. The cloud tops at the poles are warm because the atmosphere in general there is warm—why is not yet understood. At about 70° latitude a ring of colder, higher clouds circles each pole. The temperature of these clouds is about 50°C (90°F) colder than the warmest polar cloud top and about 20°C (35°F) colder than the average temperature of the planet's cloud tops. In the polar hole the cloud tops seem to be about 10 km (6 miles) lower than the cloud tops in the regions surrounding the vortex.

Above the cloud tops a haze layer surrounds the planet completely. It is about 10 km (6 miles) thick, but thickens somewhat over each pole. The polar haze is not only thicker but also appears to be opaque to longer wavelengths of infrared radiation. This could result from the presence of water vapour or ice crystals in clouds that are somewhat analogous to terrestrial cirrus clouds over the polar regions.

Detailed maps of the surface will take months to complete. The first scans by the Orbiter's radar mapper showed that over a region that had not previously been probed by Earth-based radar much of the terrain is relatively flat. At the landing site of one probe the flat surface was found to be covered with soft dust. When the probe hit the surface at 35 km/h (22 mph) it raised a cloud of dust which took several minutes to settle. Over a strip of the surface some 1900 km (1200 miles) long the surface seemed similar to that of Earth and quite different from the rough cratered terrains of Mercury, Mars, and the Moon. There was, however, a strip of about 120 km (75 miles) in which the elevation changed by about 3 km (10 000 ft), comparable with the escarpment of the Rocky Mountains at the edge of the Great Plains.

It now seems certain that the very hot surface and lower atmosphere of Venus results from a "runaway greenhouse" effect in which solar radiation entering the atmosphere is converted into heat which cannot easily be radiated into space. Of the total incoming sunlight, 75 per cent is reflected back into space from the clouds and the dense atmosphere. The remainder is absorbed mainly by the clouds, but also by the atmosphere above and below the clouds, and by the surface itself. Most of the heat energy absorbed by the clouds, atmosphere and surface is prevented from being radiated into space by the dense carbon dioxide atmosphere.

Prior to the Pioneer mission, atmospheric physicists had calculated that this atmosphere was insufficient to hold in the amount of heat needed to account for the high temperatures measured earlier by spacecraft. The finding by Pioneer of 0·1 and 0·4 per cent water vapour in the atmosphere beneath the clouds is important because this water vapour provides a second, very strong heat-trapping mechanism. Finally, the discovery of large solid and liquid sulphur particles in the cloud layers tightly seals the lid of the Venus "pressure cooker" and accounts for the planet being able to retain sufficient heat to maintain the high surface temperature. ☐

Review

'This speck of life in time's great wilderness'

The nature of life, edited by William H. Heidcamp

University Park Press, Baltimore, pp 180, ppb £6·25

If I had to write about "books that impressed me most" one of them would be L. J. Henderson's *The Fitness of the Environment*, published in 1913. In a paradoxical manner worthy of G. K. Chesterton, he wrote an essay, not about the fitness of organisms for the environment, but about the fitness of the environment for life as we know it. The temperature ranges of the Earth, the salinity of the sea, the property of ice to be less dense than water, the protective effect of oxygen in the atmosphere: without these peculiar properties, wrote Henderson, life would be inconceivable.

It is a happy surprise to find that Henderson's book (it was reprinted a few years ago) is still regarded as a classic. In *The Nature of Life*, it is the keynote for the first of the five essays in this book based on lectures given at the XIIth Nobel Conference. With Gallic elegance, biologist René Dubos reviews the place of living things, especially man, on the Earth; and he revives the old question: what is the origin of life? It is a popular piece of writing, telling the familiar story of the way in which man has influenced nature from the time of the first agricultural settlements; and not always for the worse. "Much of what we lovingly call nature," he writes, "has in fact been sculpted out of wilderness to create agricultural land." He regards man and his environment as indivisible, each organism contributing to the evolution of the environment and creating new environments from which new living forms emerge.

The second essay in the book is, by contrast, quite technical. It is by Sidney Fox, and it is a careful and detailed account of the experimental evidence for "protolife" illustrated by some interesting electron microscope photographs of artificially made protenoid microsystems, which are compared with photographs of microfossils. It has been expanded from what was presumably a lecture at the conference into a review article some 60 pages long with more than 150 references. Fox puts forward a plausible hypothesis for the way in which matter might have organised itself into the earliest patterns capable of self-reproduction.

The third essay, by Bernard Loomer, is philosophical. Its theme is the familiar one: that *Homo sapiens* is a part of the "web of life" and that the structure of webs is such that anything which happens in one part of the web may affect all the rest of the web. He discusses, somewhat opaquely, the inevitable tensions between the self and what he calls the "social self"; the self is concerned with the "realisation of his possibilities" (some would say with the safe transmission of his genes); the social self is the self which is "largely derived from and constituted by its relations with its society". This is, of course, a clumsy way of talking about the tragic tussle between selfishness and altruism; and Professor Loomer does not tell us anything fresh about this age-old problem.

Dr Peter Marler's contribution to the conference is a lively essay on perception and the origin of communication. He demonstrates how even the humble *E. coli*—the guests in our gut—can display learning, in a manner of speaking: they have, he says, about 20 distinct sensory systems, receptors responding (for example to ribose and nitrate) if and when called on to do so. From this he passes to bird-song, and reports some fascinating experiments in the perception of "local dialects" by sparrows; to which he passes on to recent work on the measurement of speech-sounds in two human languages. It is a serious contribution to the conflict between those who assume "innate knowledge" of a language (as Noam Chomsky does—though Marler doesn't like the term Chomsky uses), and those who assume that language is picked up empirically; and it is cleverly related to the wider problems of the philosophical nature of perception.

The last essay, by Max Delbrück, goes back (as Dubos does) to a classic: this time Erwin Schrödinger's little book *What is Life?* He covers, though in a very elementary way, the story told much more technically by Fox, about the evolution from primordial "soup" to higher organisms, and then considers whether mind can be accounted for as a product of the central nervous system.

For many it will be familiar ground, until he gets to the end. At that point he introduces an idea taken from a recent book by C. Bresch (*Zwischenstufe Leben*), which (as Delbrück puts it) has a "sinister feedback loop". It is, briefly, this: language evolves, in the form of dialects, much faster than the biological evolution of those who talk the language. The linguistic differentiation which occurs permits an easy recognition, among neighbouring communities, of conspecifics belonging to "us" and "them". This in turn is likely to cause little pockets of chauvinism, which, when allied to instincts of aggression if there are shortages of food or *Lebensraum*, will precipitate conspecific conflicts. And—an interesting speculation—there may be a selective advantage in these conflicts to the community with the better means of communication, that is, with the more advanced and flexible language. This new differentiation, writes Bresch, "led to a criterion of whom one could kill. . . . Common language produced a completely new and intense feeling of belonging together".

It is a mixed bag of essays, ranging from the sophisticated to the trite. They have no coherent theme to bind them together. Apart from the review article by Fox, they do not contain information or ideas which cannot be found already in print in many books and journals. It is certainly a book worth paging over if you find it in the library, but it is not worth buying for yourself.

Eric Ashby FRS

Rencin

Why I left Canada: reflections on science and politics, by Leopold Infeld (McGill—Queen's UP, pp 212, $11·95). Infeld was a Polish theoretical physicist who worked with Einstein on field theory during the 1930s and afterwards settled in Toronto. His sense of social responsibility led him to lecture widely on the atomic bomb, but some Canadians did not like being told that the Russians would probably be able to produce a bomb on their own in three or four years. They thought that Infeld must have atomic secrets and should therefore be prevented from visiting Poland as he had planned. The criticism became so unpleasant that Infeld returned permanently to Poland in 1950. There he was equally outspoken against the Marxists who criticised Einstein as an "idealist", and was for some time under a cloud. He was nevertheless able to establish a school of theoretical physics in Poland, and finally died there in 1968.

This book is a rather uneven collection of autobiographical reminiscences translated from various Polish journals, together with sketches of Einstein, Bohr, Oppenheimer and Planck. The subtitle better indicates the contents as the account of the Canadian episode occupies only part of the book. It is a sad story, showing the acute distress suffered by an excellent scientist and a courageous and humane man caught up in world political upheavals. P. H.

Migration, birds inland and birds at sea*

Animal Migration, despite its many striking coloured illustrations, is not merely a coffee-table book, but a comprehensive review of the migrations of animals, from mammals to planktonic crustacea. Professor Cloudsley-Thompson introduces the subject with an account of the ancient explanations of migration, from the Old Testament and Aristotle to Linnaeus and Gilbert White. He then examines the mechanics of migration, as now established, before considering migration by air, land, and water. He discusses the problems of navigation for birds, summarising the experimental work that has been carried out in the attempt to elucidate how it is done, and suggests that "time-compensated solar (or celestial) navigation" is the most probable mechanism. He does not, however, point out that navigation using the Sun's meridian altitude and a chronometer cannot be achieved without the use of a chart, material or mental, and knowledge of the position of the desired destination.

After discussing the evidence about the mechanics of migration and orientation in insects and other arthropods, the author suggests that in mammals learning plays a far more important part than instinct in following migration routes, and that consequently there is far less evidence for celestial navigation among them. It is unfortunate that his book was in print before R. R. Baker's work on the migration of vertebrates appeared, so that Professor Cloudsley-Thompson is unable to discuss the proposition that vertebrate migration is no more than an extension of the home range derived from exploration, learning, and memory, without the intervention of any senses yet to be discovered.

The author concludes his book with an account of the alternatives to migration, such as hibernation or the diapause in the life history of many insects, that tide animals over bad times until better conditions return. In addition to the pictures, there are many maps, a short bibliography and a good index.

Birds of Ocean and Estuary, and *Birds of Mountain and Moorland* are the first two volumes of the projected five-volume *Orbis Encyclopedia of Birds of Britain and Europe*, edited by J. Gooders, describing every species of bird that inhabits or has ever strayed to Europe. The first volume opens with general information on bird classification, habitat, and identification, and then deals with each family in turn, giving details of those species that have been found in Europe.

The treatment is so wide that many birds that are merely the rarest of stragglers to Europe are included. This is no disadvantage, for it gives the bird amateur, for whom the encyclopedia is intended, a much wider appreciation of the world's bird fauna than would a more restricted work.

Both volumes are lavishly illustrated with colour photographs, paintings, maps and diagrams, and conclude with short lists of books for further reading, and full indexes. These volumes are far superior to many other illustrated books compiled by teams of anonymous "researchers"; the amount of information given will interest, and its attractive presentation will delight, bird watchers both young and old.

L. Harrison Matthews, FRS

***Animal migration**, by J. Cloudsley-Thompson *(Orbis, pp 120, £5·95)*; **Birds of ocean and estuary**, edited by J. Gooders *(Orbis, p 264, £7·50)*; **Birds of mountain and moorland**, edited by J. Gooders *(Orbis, pp 264, £7·50)*.

Bird families of the world

edited by C. J. O. Harrison

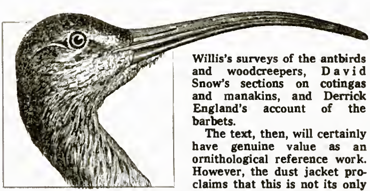
illustrated by Ad Cameron

Elsevier Phaidon, pp 264

£9·95

As the title implies, this book presents its information about the world's birds on a family by family basis. It is by no means the first to do so; *Living Birds of the World* by Thomas Gilliard (1958) and *Birds of the World* by Oliver L. Austin, Jr. (1961) are well known predecessors organised in a similar way. It differs radically from these, however, in the use of a panel of contributors to provide the bulk of the text. In this way it should perhaps be compared more with the family accounts included in the *New Dictionary of Birds*, edited by Sir Landsborough Thomson (1964).

The panel system works best when authors are chosen for their specialist knowledge of individual families, as was the case with the *New Dictionary*. In the present book, certain authors have written on a wide range of families, and thus rank more as sub-editors. Nevertheless, there are also some excellent accounts by ornithologists whose work has concentrated on particular families, and these provide welcome updating of the *New Dictionary's* family reviews. To pick out a few, I was particularly pleased to read Edwin Willis's surveys of the antbirds and woodcreepers, David Snow's sections on cotingas and manakins, and Derrick England's account of the barbets.



The text, then, will certainly have genuine value as an ornithological reference work. However, the dust jacket proclaims that this is not its only function, and stresses the visual presentation of information. Here the standard is more erratic. Ad Cameron, the artist, is an excellent technician, with a fine sense of design, but he is inclined to be wayward, especially when portraying action. The captioning is occasionally curious and inapt, and one feels that liaison between artist, caption writer and editor was not all that it might have been. Nevertheless, the general standard of production and layout is high, and the price very reasonable.

Philip Burton

Natural zeolites

Occurrence, properties, use

by L. A. Sand and

F. A. Mumpton

Pergamon, pp 546, £42

This is a rare success story—the rise of a group of minerals from museum obscurity to industrial eminence. Zeolites are a series of alumino-silicates with open framework structures within which nestle water molecules and alkali metal ions. While the atomic framework may survive heat or acid attack, the "furniture" can be removed; the alkali by providing a rival ion; and the abundant water by heat, whereafter the structure is porous to alternative molecules. Having evacuated the zeolite it is possible, through choosing from among the 50 natural and synthetic species, to find the structure with the appropriate molecular channel size for a particular problem of selective adsorption. The smaller molecules become trapped, the larger ones remain free (paradoxically the synthetic species are known as "molecular sieves").

Uses for this selective adsorption are numerous: in removing radioactive caesium or strontium from nuclear waste, ammonia from sewage, sulphur dioxide from industrial fumes, nitrogen from air to leave almost pure oxygen, etc, and in all instances the reaction can be reversed, the zeolite is reusable. (The dehydration - rehydration cycle can even be used to generate solar energy.) Zeolites are also used as paper fillers, gasoline catalysts, building materials and polishing agents in fluoride toothpaste. An industrial panacea?—there is more—"pigs on a diet of 5 per cent clinoptile (zeolite) gained up to 25 per cent more weight than those on normal diet" and "had markedly lower death rate". Bizarre? ("Domestic animals can be fed up to 40 per cent clay with no adverse effects"(!).)

The academic angle is not entirely played down in these papers, that were given at a tub-thumping first conference of natural zeolites in 1976. Once a mineralogical rarity, they are now recognised as common but cryptic constituents of many altered volcanic rocks, the particular zeolite formed being critically dependent on starting material.

Given the limitations of a conference proceedings, all the above is covered very well. One area conspicuously absent, however, is the possible health risks of fibrous zeolites that occasionally share a similar morphology to the vicious crocidolite asbestos.

Robert Muir Wood

The world atlas of mysteries

by Francis Hitching

Collins, pp 255, £6·50

The word "Atlas" in the title presumably implies this is meant for a work of reference. If so, the author is sadly lacking in the necessary critical faculties, and his research was sloppy.

To give the impression of impartiality he quotes some well-known demolition jobs done on non-mysteries, thereby bulking a flimsy book. But after pretending judiciously to balance argument and counterargument (done, often, by elevating the unlikeliest people to the rank of "world authority") he spoils the show by presenting his own laughably stupid "verdicts".

But this one expects. What is surprising is the sheer number of elementary errors. Opening to one page at random, which happened to be p 112, I found Martin Gardner, the writer of "Mathematical Games" in *Scientific American*, is described as a psychologist, and Jonathan Swift's celebrated satire on science is supposed to have been part of Gulliver's stay in Lilliput rather than Laputa.

Hitching has not even read his *own* book. After dismissing pyramid numerology as "pyramidiocy", he later uses the self-same numerology as evidence *for* mysteries. The only real mystery about this book is that people will buy it.

One happy thought did strike me in reading it. Hitching's first mystery attributes the extinction of the dinosaurs to a nearby supernova. His third attributes the extinction of animals to reversals in the Earth's magnetic field (notice the discrepancy?). His fourth is the spontaneous combustion of people (did you know that your body, 90 per cent water, is a fire hazard?), which he attributes to infinitesimal fluctuations in the Earth's magnetism setting off catastrophic chemical chain-reactions. And he proceeds to claim that dowsers can detect such fluctuations at the level of 1 part in 10^9, and so can tell, for example, that megaliths invariably stand at sites significant for their force fields.

I propose a theory, which is mine, that these phenomena are all connected (if that poor word is still used in polite society). Dinosaurs all belonged to the Saurian Society of Dowsers, and were wont to lounge about at magnetic nodal points, getting good vibes. Then one day a nearby star went bang, caused the Earth's magnetic field to reverse, and all the dinosaurs lit up like a box of Vestas. Mr Hitching is, of course, a member of the British Society of Dowsers . . .

Martin Goldman

Drugs and the Third World

by Anil Agarwal

Earthscan, pp 70, £1·50

Of the $2 billion or so spent annually on drug research all over the world, until the mid-1970s only $30 million was for research into new treatments for infectious tropical diseases, to which one billion of the poorest people in the world are exposed. But when multinational drug firms begin manufacturing in developing countries, as much as 90 per cent of the output of some of them may be profitable lines like vitamins and cough syrups, which only the local rich can afford and almost certainly do not need.

These are but two aspects of what Anil Agarwal calls the undeclared war against "drug colonialism". While he is able to record some modest successes in "national self-reliance" and suggests how more might be achieved, overwhelmingly the picture presented is of a powerful industry, based in the developed countries, ruthlessly forcing on the poorest ones goods of its own choice and in return catering little for their most pressing needs.

Some of the sources are listed in a brief bibliography and in the text. They include reports from WHO, various UN agencies and Third World governments. But as the work was originally published as a service to the media, it is unfortunate that references are not given for the many telling quotations cited from spokesmen of the drug companies in defence of their actions and policies. The booklet nevertheless merits wide circulation, not least for its account of what the poorer countries are doing to help themselves—with some support from outside.

Frank Lesser

Listening to lectures*

Oxford UP

Most science lecturers are only too familiar with the difficulties faced by a large percentage of overseas students whose English is inadequate. To date, not much specialised audio material has been available to help them, but these self-study packages will go some way towards rectifying the situation. Each consists of a C-60 tape cassette with a booklet of graded exercises and keys based on the recorded material. A student may therefore play the taped extracts of live lectures which have been given to real UK undergraduates and work his way through the exercises as many times as is necessary.

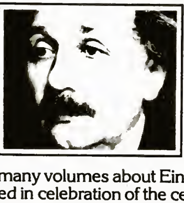
In all cases, the arrangement of the work follows a similar pattern, commencing with 13 or more exercises, based on extracts from introductory lectures, which develop a person's abilities in comprehension and analysis as well as providing for an improvement in technical vocabulary. Side 2 of a tape deals in some depth with a specialised subject area and aims for a further development of the qualities required for successful completion of the first side. Thus, the *Biology* tape deals with homeostasis on side 1 and "The Insulin Story" on side 2, while the *Sociology* package covers social policy and then income maintenance in Britain.

Since no concessions have been made by way of language simplification or speed of delivery, there seems to be a real chance that continued practise will enable an individual to comprehend a particular technical lingo and improve his note making. However, the successful pursuit of any special subject to graduate level requires the development of many language-based skills and it will be interesting to see whether one tape package per subject is sufficient to give foreign students enough lift-off to tackle the introductory parts of a British degree course.

Peter J. Baron

---

* Five tapes : Biology; Government: Mechanics; Computing: and Sociology, by Jo McDonough, £5.50 each



EINSTEIN
THE LIFE AND TIMES
RONALD W. CLARK
INTRODUCTION BY SIR BERNARD LOVELL

'No doubt many volumes about Einstein will be published in celebration of the centenary of his birth but the scope of Mr. Clark's book and his insight into the nature of Einstein's life and work will endow this book with a special and lasting significance'.
Sir Bernard Lovell

£6.95
Hodder & Stoughton

The physics of vibration, volume I

by A. B. Pippard

Cambridge UP, pp 431, £22·50

In this volume the Cavendish Professor of Physics at Cambridge University provides an informative and interesting account of the properties of a wide range of vibrating systems, all of which are analysed on the basis of classical physics. He defers discussion of phenomena requiring a full quantum mechanical treatment and the investigation of complex systems to the second volume of this set of two.

Many books dealing with vibrations have already been published and authors have little scope for introducing novelty into their texts. In this distinctive book the list of chapter titles looks fairly standard. The narrative, however, takes some unexpected turns, and the reader who perseveres will be able to look back with satisfaction saying "So that's where that fits in!" Professor Pippard succeeds in providing insight into the physics and exposing the common features in the analysis of apparently unrelated phenomena.

Volume 1, then, deals with the simple classical vibrator. The restriction to phenomena amenable to classical analysis does not, of course, preclude consideration of topics of current interest in physics and engineering. Among the topics that the author uses to illustrate the basic principles are masers, speckle patterns produced by laser beams, operational amplifiers in feedback circuits, the scattering of neutrons by crystals, and the Josephson effect. The emphasis throughout, however, is firmly on fundamental principles rather than technical details, and such topics although extremely interesting in their own right have not been allowed to dominate the text.

The discussion starts with chapters introducing the free vibrator, applications of complex variables to linear systems, Fourier series and integral, and spectrum analysis. The basic ideas of the response function having been introduced by this stage its usefulness is exploited in the following chapter on the driven harmonic vibrator. Vibrations are often linked with waves but, as the title of the book implies, little attention is paid to wave motion; there is one chapter entitled "Waves and Resonators". A chapter follows on velocity-dependent forces in which whirling, nuclear magnetic resonance, cyclotron resonance and helicons are discussed. The last four chapters are devoted to the driven anharmonic vibrator, parametric excitation, maintained oscillators, and coupled vibrators.

That physics is essentially an experimentally based subject is stressed repeatedly. The reader is exhorted to carry out experiments where possible and at one point to set up an oscillating system whose tuning is so delicate that it is virtually impossible to exhibit the desired effect. Nevertheless, "the reader is encouraged to try, since more can be learned about the physical processes by being frustrated than by accepting defeat at the bidding of the printed page" (p 287). Many of us will recognise the feeling more easily than the truth of this statement!

A good knowledge of basic mathematics, particularly complex algebra, and physics or engineering science is needed to cope with the material in this well produced book. Mathematical details are given where they shed light on the underlying physics, but readers should be prepared to check and expand the mathematical arguments; a few minor errors have passed undetected. Also more detailed labelling in many of the figures would have been helpful.

This book is not really suitable for use as a recommended text associated with a conventional lecture course, nor is it intended that it should, as the author himself points out. In my opinion, the approach, the range of material covered and the emphasis on underlying principles throughout make it an ideal book to recommend for general reading by senior undergraduates and graduates in the physical sciences. Perhaps an upsurge of interest in *The Physics of Vibration* will occur periodically as successive generations of students, about to enter their final years, retire for the long vacation armed with copies. This book stimulates thought and study of it will be well rewarded.

David Vass

In the centre of immensities

by Bernard Lovell

Hutchinson, pp 174, £5·50

This is a disappointing book. The reason for the disappointment, however, lies mainly in the buildup which it has been given, leading the reader to expect something really special, rather than in the book itself. It is presented as "Volume 53 of the Introduction to World Perspectives", and the jacket tells us that Sir Bernard describes "a brief flash of time in the centre of immensities during which the infinities and infinitesimals of mathematics enclosed a variety of expanding universes". Hot stuff indeed—but not what this book is about.

The package we have is a fairly conventional, thoughtful book about astronomy by an *eminence grise* of the discipline. Sir Bernard looks at his subject from the point of view of the historian of science, discussing man's understanding of the Universe and his place in it from the context of the views of Ptolemy, Copernicus *et al*, before coming on to modern ideas and the "big bang". The final chapters consider the confrontation between man's creative activities and his potential for destruction and ponder on human purpose and the progress of civilisation, without saying anything new or particularly interesting.

It is a quiet book, non-mathematical and providing a good read for the non-scientist who wants to know something of how modern science sees man's place in the Universe. But it is not a dramatic and exciting account of what is going on at the sharp end of cosmology today, and any reader who buys it on the strength of the publicity will be sadly disappointed. Does the Trade Descriptions Act not apply to books?

John Gribbin

Bookwatch

Book-packaging—a reply

As a partner in one of the book-packaging firms referred to by John Powell (Bookwatch, 11 January, p 106), may I try to put straight the record about the early origins of British book-packaging.

I have always understood that the real pioneer of book-packaging was Wolfgang Foges, the present managing director of Aldus Books Ltd, London. Even after 41 years it seems that his unique contribution to international book publishing is still not as widely recognised as it should be.

Let me at once declare an interest. I started to learn my trade when I worked for Foges many years ago, and must therefore be content only to draw readers' attention to what I believe are the facts. But in so doing I wish to speak up for the man described by Anthony Blond, publisher and novelist, in *The Publishing Game* (Cape, 1971), as "the father of them all". Indeed, Colin Ridler begins his *Out-house Publishing* (Oxford Polytechnic Press, 1976) by saying: "Out-house publishing [ie packaging] in Britain began with Adprint Ltd, a small production company set up by Wolfgang Foges in September 1937 ... Foges had been a publisher in Vienna, producing books in the contemporary continental style with illustrations (chosen by 'picture researchers') carefully integrated with texts. British publishers of the time had little or no experience in this field ('picture research' as such did not exist), so when Foges arrived in England he found a new and unexploited market for his visually orientated books."

Incidentally, your readers may be intrigued to know that the men employed by Foges during his pioneering days in London included Walter Neurath (later founder of Thames and Hudson Ltd), Max Parrish (Max Parrish Ltd) and George Rainbird, described by Mr Ridler as "the man who copied and then successfully developed the Adprint formula".

Nick Russel
Russel Sharp Ltd, Guildford

Wolfgang Foges initiated the *King Penguin* series, and his subsequent projects included *Britain in Pictures* and *New Naturalist*, both in conjunction with Collins.—Ed.

Forum

A GROUNDLING'S NOTEBOOK

A close shave

Donald Gould

"Lives are at stake", said Mr Ennals, not long ago.

The Secretary of State responsible for our great national health service and for all the rest of the twiddle and the twaddle that goes with the long aftermath of the Beveridge Report was talking about the inclinations of ambulance men to sit down and stop working if the community in which they serve couldn't be bothered to pay them a living wage.

I'm sorry to have to say this about a respected and honoured officer of state, but I think our David was talking a load of old crap.

I have once, in the course of a now quite tediously long life, required the services of an ambulance, and of ambulance men. I was, one day five or six years ago, dictating a quite stirring leading article for the *New Statesmen* (I forget what it was about, but I remember that it was well received) when I quite suddenly felt faint, and cold, and started to sweat, and, possibly as a result of information sent up to my brain from various receptors in the belly and elswhere (but only subconsciously received) I knew at once what was happening.

I was bleeding into my guts, and possibly to death (there's a high mortality rate from this kind of incident), and sc I walked very carefully upstairs to the bedroom, calling upon my dear secretary to follow me if she cared for me at all, and to listen carefully to every word I had to say, and to follow my every instruction.

She was no fool, and recognised that somethingly slightly out of the ordinary was afoot, and didn't waste time, or any of my rapidly draining store of vital energy, in arguing, but escorted me to the couch upon which I gratefully collapsed.

She then saved my life by quickly doing what I asked, and by bringing me a couple of pints of water to drink, and a couple of hot water bottles to keep me slightly warm, and by ringing up our friendly neighbourhood GP, and my dear wife, who was at work, and by telling them both that they'd better come, and then (and almost certainly most helpfully of all), by sitting beside my bed and taking down the rest of that bleeding leading article (if I may be excused the use of that particular epithet) during the next fifteen minutes or so which had to elapse before the cavalry arrived.

I really do think that this last action may have been life-saving. The fact that I was "getting off my piece" possibly calmed me and my circulation down far more effectively than any pharmaceuticals could have done. The task certainly kept me from pondering too deeply upon some pretty pressing intimations of mortality. By the time I'd finished dictating my copy—and to the right length within a dozen words, as I now recall—I was well over half-way to recovery.

I say this in retrospect. The point I am somewhat laboriously trying to make is that the saving of lives very rarely does depend upon instant and urgent action undertaken by employees belonging to NUPE, NALGO, COHSE, ASTMS, TGWU, members of the BMA, Fellows of the Royal College of Physicians, Permanent Under-Secretaries at the DHHS, or even Secretaries of State.

I think the ambulance arrived something like a couple of hours after the start of my abdominal catastrophe. I had a drip put into a vein three, four, or maybe five hours after the whole incident had started. Over the course of the next few days I received six or eight pints of blood (for which I am most truly grateful), and some of them weren't as quite well-matched as they should have been, so that I shivered a little, and so that my temperature peaked from time to time, and while I'm sure all this helped in some way, I'm also enormously glad that I managed to escape from the hospital in about a week (I had, practically, to get a High Court injunction to escape from the place) still feeling pretty shaky, but quite certain that I was much safer back home.

I'm telling this tale because, apart from a couple of near misses during the war, it is the story of my closest approach to death, and I don't really believe that most of my fellow beings who may similarly flirt with the grave go either back or forth because of the lack or availability of "professional" attention, but that they go the one way, or perhaps the other, because that is the will of God, or the swing of the balance, however you may like to look upon the matter.

It has already been well shown that unfortunates struck down by a coronary occlusion do (statistically speaking) just as well whether they be nursed at home or in the most expensively equipped and expertly staffed intensive care unit of some prestigious great hospital. And, given the space and the time, I could produce further evidence against the value of high-technology medicine.

So, when Mr Ennals claims "lives are at stake" I say to him "Oh, no, they're not, sir! All that's at stake is whether we're willing to pay some solid, but not all that essential, public servants a decent wage for a job which is usually done with both efficiency and compassion." □

THOUGHTS OF SORTS

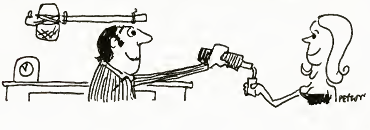
Droning on

Colin Tudge

Pop soc is the name of the game: man the predator, woman the victim, fossicker, siren, status symbol, and general perverter of enterprise. It's all these genes we've inherited, you see, and the primitive stirrings that go with them. We were moulded, by natural selective forces that no longer apply, to conditions that no longer exist. We need the challenge of weather and terrain, but live in centrally heated penthouses; the companionship of small hunting bands but are programmed into bureaucracies; the contact of the flint axe head and the Machiavellian purloinings of the chap's next door but are excluded from the means to our own succour and have learnt to stand in line with our fists full of luncheon vouchers. We are unfitted to the world of our own creation, victims of our own technology and of its underlying logic. That is at the root of our frustrations, and the wars, crimes, strikes and general batterings that spring from them.

Anti-pop soc is the name of another game which says that pop soc is lucrative but fundamentally daft. Mankind, hallooing on the pampas and chipping away at his totem poles, has always been bored, frustrated, feckless, fundamentally idle and happy to be led along the lines of least resistance—mankind, in common with every other gregarious, intelligent creature. Our fellows and fellow animals in a state of nature are no more fulfilled then we are; and though we may learn something about ourselves by looking at them, we may in the end learn much more about them by looking at ourselves.

The deer and the lion are noble beasts; handsome, strong, fearless, and uncompromisingly masculine; the females elegant, maternal, and discreetly coquettish, but content in the end to take their lead from their noble-browed patriarchs. Victorians selected both creatures as natural metaphors for themselves, epitomised above all by Sir Edwin Landseer, with his *Monarch of the Glen* and his gentlemanly if mildly lecherous Trafalgar Square lions. Neither were these creatures regarded merely as metaphors; the society of Herbert Spencer was anxious to find



natural precedents, to demonstrate that its own tough imperialist structure was itself "natural", the end point of an ineluctable evolution.

Twentieth century biology has made some nasty dents in those metaphors. The monarchs of the glens are full of warble fly, and they are runts. If you keep them in parks they grow half as big again. Neither is the stag's monarchy undisputed. He struts and frets convincingly enough during the rutting season but if there is any real trouble around it is the hinds who decide which way to turn, and he follows.

Lions are absolute sods. They fight their way to mastery of a pride and then they kill off as many of their predecessors' cubs as they can lay paw to; infant mortality in lions is around 80 per cent and most deaths can be pinned on the step-father. They then do as little as possible. They don't do a lot of hunting, not because they are not particularly good at it (neither sex is particularly good at it; that is another myth) but because they are bigger than the lionesses and know that they can always bash their way into a share of the kill. Their prodigious sexual appetites are satisfied by the commensurately egregious randiness of the females during their frequent heats. After a year or two the boss lions are thrown out by a couple of new young bloods, who then settle down to a well-earned bout of infanticide and indolence.

Primates are no improvement. Most males in a baboon troop show only enough bottle as it takes to make mischief. Gorillas are more admirable—free-and-easy, democratic creatures—but then they have very few worries and according to George Schaller they rest for 19 hours a day with a lie-in on Sundays.

Anti pop soc suggests, indeed, that we have created the kind of soft, indolent and querulous society we have, precisely because we are soft, indolent and querulous. We have not defied our nature but have simply used our wit to follow it through. A primitive man in a penthouse flat would be as happy as Larry. Bored, of course, but content enough, as he has always been, to pay that small price of comfort. □

PLACES

Moscow sick

Jane Moore

To push the red emergency button in desperation knowing you really can't wait any longer for a bedpan—and to receive no answer—is an alarming experience, especially if you happen to be in a Soviet hospital and haven't the slightest idea of the appropriate Russian word anyway. When this happened to me, I was eventually rescued by a fellow patient.

On my first day in hospital, I had developed a dangerous passion for the only surgeon who had taken the trouble to explain exactly where he was intending to cut me open while three others were frantically screaming "operatzio" and supposedly adding "appendicitis" in Russian. When I remarked later that my toothpaste and shampoo were not only rare sights but indeed desperately coveted by other patients, he told me not to worry in a marvellous Anglo-Russki accent. "Most foreigners are sent to this hospital—its considered to be one of the best and most hygenic". My bloodstained bedclothes, however, might have been changed *once* during my week's stay, although the sound of the cleaning lady's buckets was admittedly frequent and brought instant smiles to the sick and needy.

The cleaning lady was a rosy-faced wrinkled "babushka", who spent her time—on or off duty—amusing everyone with her incessant chuckling and babble of nonsense. At intervals, she would be severely reprimanded by Alla, the cook, who always knew her whereabouts by the clean buckets left proudly outside each ward. Alla in the meantime sweated it out in the kitchen producing such inedible delights as mashed potato flavoured with crumbs of fat, faggots questionably flavoured with meat and undoubtedly mashed with lumps of fat, and sometimes, as a special treat, salty cabbage soup. *Pièce de resistance*.

Being English created great excitement; I was awarded many privileges. The huge blobs of butter on my semolina pudding in the evening and four extra lumps of sugar to add to the daily quota of six handed out carefully every morning were two I'd have liked to pass on to a more deserving recipient. It was almost impossible to dissolve the sugar in cold black tea and as I've never taken the stuff anyway, drastic action seemed necessary when a nurse quietly placed a cup of half water, half sugar in front of me one day because I hadn't consumed my full ration. I took to surreptitious smuggling operations. All surplus sugar lumps, together with a mounting pile of equally sickly chocolates (which had in turn been smuggled to me by other well-meaning patients), were removed speedily from my bedside via friends' pockets and chucked into the nearest available wastebin.

FUNNY THEY'RE JUST LIKE US
PEYTON

Luckily I was allowed visitors every evening—the official allowance was twice a week. On the first of these occasions, the five women with whom I shared a ward tidied up and placed chairs in a pretty pattern around my bed, intent on creating a good impression for this Big Event. British aliens then poured in sporting regulatory white coats, hovered around with Japanese cameras and even announced themselves to be insanely jealous—after all, I was going to learn more of the Soviet way of life than they were. Western literature and a duty free plastic bag brought further fame when they left. A Nepalese medical student offered the best deal for the exchange of the plastic bag: a "medicinal" herbal potion resembling strong rum. My jaundiced neighbour timidly asked if I might let her have a picture of a London policeman from the front page of the *Morning Star*, the only English newspaper available on most bookstands.

Two days after my operation, a physiotherapist came to see me. Refusing to believe I couldn't understand her Russian commands (the tone of which was worthy at least of an army sergeant), she pulled me about ruthlessly with a sadistic gleam in her eyes. I was grateful later when I found I could at last hobble along the corridor to watch television . . . a fashion show on Moscow modes was reporting on the cult of mini-skirts and chain belts. As soon as this programme showed signs of coming to an end, a resident student proceeded to plague me with questions on Shakespeare's life. The ITV film *William Shakespeare* had recently been shown as part of Soviet TV's British week. He was amazed to find my knowledge of the subject to be far from perfect but blamed this regrettable fact on our distressingly inadequate education system. There followed a stream of propagandist statistics of the vice and violence in "Big London City" (New York would doubtless have left him frothing at the mouth); this concerned young man obviously pitied me returning to such a scandalous life.

As time went on, the opportunity for me, too, to speak openly with no taboos, became taken for granted. The surgeon provided my five fellow patients with Russian-English dictionaries. Whereas my previous conversations with Russians had revolved around the glorification of Soviet socialist realism or extolling the efforts of the local groups of sanitary engineers, our talks considered the more relevant facts of life. It seems clear that in this vast, complex, mind-expanding country there has been very uneven development; consumer goods and comforts are way behind the cultural and technical amenities. Women begged me for make-up, especially mascara which is sold in the form of boot polish on street corners for an extortionate price. The men desired only chewing gum, which can be swapped for anything from a taxi ride to a pair of leather army boots . . . or sold on the black market.

The surgeon reassured us once more by praising the progress of Soviet medicine since the time of the revolution, when there

Forum

continued

was much disease and starvation. He described the seriousness with which the Soviet authorities now regard the role of health and fitness in ensuring an efficient, productive population. Health holiday centres are being built on a large scale throughout the Soviet Union and all medical assistance is free. "Not long ago," he said cheerfully, "enormous placards with slogans such as 'Help the country with a toothbrush' were as common as the all-pervading Lenin posters of today".

The latter revelation seemed to me to be a further example of the rather bizarre sense of humour of the Russian race. I had come across an amusement arcade in full swing inside the stately Petrogov Summer Palace, once the residence of Tsars, near Leningrad. On my last day in hospital, the surgeon presented me with a small metal badge. A red star surrounded a photograph of the by now familiar features of the great leader himself—but as a baby with curly blonde hair, Lenin looked more like a she than a he. Badges such as these are extremely popular in the USSR and I had already collected quite a few. So with Baby Lenin, Middle-Aged Lenin and Ancient Lenin firmly pinned to my original English duffle coat, I made my way happily from the catacombs of the sickly to the main exit. On the wall was an impressive notice: "This hospital has received the highest order of Lenin". Well, if I'd known *that* before . . . ☐

LUNATIC FRINGE

IFOs

John Gribbin

The lunatic fringe had a great time as 1978 gave way to 1979. As well as the usual celebrations enjoyed along with everyone else, they had the pleasure of a spate of UFO sightings, the most publicised coming from Italy and New Zealand. Fuzzy blobs and lights in the sky were filmed by respectable TV news teams, and much was made of the fact that these teams are honest, reliable and stand to lose their jobs if caught hoaxing; less was made of the fact that it is possible to make mistakes without being a deliberate hoaxer, or indeed of the possibility that there might exist TV stations in the world that would welcome publicity and provide news teams with bonuses for achieving public attention without looking too closely at their sources. But, without proof yet one way or the other of just what it is the film crews have snapped, the objects remain "unidentified"—and that pinpoints the curious difference in interpretation of the term "UFO" between flying saucer buffs and scientists.

To a scientist, the initials are an acronym for the description "Unidentified Flying Object". Obvious enough, you might think, and hardly worth elaborating. Whatever we see in the sky, and however many flying objects are identified as weather balloons, meteors or Venus rising, some will never be positively identified and therefore go on file as UFOs. Alas, however, to the fans "UFO" is no longer an acronym, but a new word Ufo (pronounced "you-foe", with the implication "me-Jane") which is another term for flying saucer. UFO, to them, means, spaceship from another planet manned by beings much more wise than humble earthlings." So a scientist asked on TV "have you ever seen a UFO?" will always, if honest, reply "yes". And next day the headlines scream "Scientist says little green men exist".

This is simply a question of terminology, demonstrating the richness and life of the English language. Words mean what their user intends, as Humpty Dumpty spelled out so clearly, and problems only arise if two users intend different meanings for the same word. Words also change their meaning, as another highlight of the festive season demonstrated. On New Year's Day, with all but four football matches in the English league programme cancelled because of snow, one commentator repeatedly referred to the fixture list as having been "decimated". Only a pedant would argue that this usage is incorrect, since the origin of the word implies one match in ten cancelled; everyone knew what the commentator meant (devastated), and no confusion resulted.

But the situation is different with UFO, and my conclusion is that the time has come for scientists to retaliate by coining a new term to describe what they mean by UFO. My contender for this role is the word "IFO", which works in exactly the reverse way across the communication gap back to the saucer buffs. To a true believer, IFO can be taken to mean "Identified Flying Object", since all true believers know about our visitors from space and, in their own minds, the flying objects are clearly identified. (There is a more subtle point here regarding UFOs; the less you know the more "unidentified" objects you will see in proportion to conventionally explained sightings, and if all UFOs are flying saucers this gives the believer every incentive to avoid learning about planets, meteors and so on.) The acronym will remind scientists of the interpretation put on their comments by the faithful, perhaps reducing the number of sensational mis-quotations, and the word itself puts the whole thing in perspective for the sceptic.

If these objects are not weather balloons, *if* the observers are honest, *if* there are intelligent beings on board, *if* they do have awesome powers unknown to man and *if* they wish us no harm but want to teach us peacefully how to progress to a more civilised state, then why do they only reveal themselves to the lunatic fringe? *If* the lunatic fringe has evidence to support their claims that "We Are Not Alone", why don't some of them put the bite on the Cutty Sark company, currently offering £1 million for proof that we are visited by beings from outer space?

Of course there is a simple explanation, one offered to me several times during my career as a science writer. "They" have not just visited but taken over the world at government level, so that a massive conspiracy prevents the news reaching us lesser mortals. If so, it is too late to worry, but if "they" really are running the show, I for one don't think much of their awesome powers and wisdom. ☐

MEDIA MESSAGES

It's a good job

Tim Robinson

It is, I fear, just one more symptom of Fleet Street's general malaise that despite Britain's most famous daily newspaper being missing from breakfast tables for the past 10 weeks, a reasonable and continuing discussion of its plight has been almost completely absent from the columns of its brothers and sisters. *The Times*, when it is written about at all, is referred to in a subdued hush people often affect when mentioning the recent dead. And, I suppose, if there is nothing so dead as yesterday's news, then there is something more corpse-like still about a newspaper that's not producing today's news. In the Gray's Inn Road these days they know not just what a corpse looks like but how it feels to be treated like one.

It was partly because of this feeling of mordant necrosis that both the NUJ chapels (union branches) of the *Sunday Times* and *The Times* decided to produce their own versions of what has been, and is, going on. *The Sunday Times Reporter* and *The Times Challenger* have now both appeared. It is sad in the extreme that these two groups of near redundant workers should have found it impossible to combine. Even in the present dire straits a long legacy of animosity between the lower paid *Times* journalists and their richer colleagues over the bridge has not been buried. It is sad too, that *The Sunday Times Reporter* should say that the issue of the "new technology" is separate from both unofficial stoppages and manning levels. Certainly it has a great deal to do with the latter. That managers in Times Newspapers Ltd should lump them together is less a plot to try to force a settlement of all issues at once, more a recognition by someone somewhere that there can no longer be a distinction made between them.

At root, management has been able to define the course of the stoppage all along, partly, in my view because the journalists, as one glaring instance, have failed to link computer setting with their own futures—or anybody elses for that matter. Look at it this way. If we take crude measures of the costs in producing a newspaper we might divide it thus: man-power (for a quality daily) might be 39 per cent; distribution and overheads, 23 per cent; newsprint and ink, 28 per cent. It just so happens that whereas newsprint had risen by 147 per cent between 1970 and 1975, earnings for manual workers in Fleet Street had risen "in line with national average earnings" (from the Royal Commission on the Press).

Newsprint has continued to rise steeply in price—with another increase on the way this year. Part of the problem is that 75 per cent of newsprint is imported and there is some evidence that one of the major suppliers to the UK, Finland, is trying to corner the market in order that its suppliers can dictate all future prices. As a cost, therefore, it cannot be reduced.

Similar problems attend any efforts to reduce, or keep stable, fixed overhead costs, like rates, electricity and telephones, or distribution—particularly the railway trains, or the armies of vans used for deliveries. Any management looking at its costs would leap upon the new computer typesetting equipment, and all its peripherals, because, when the rhetoric is stripped away, they imply labour-saving. Anyone who does not believe that should look to the United States where the equivalent union to the NGA has been wiped out by computer technology.

Finally, it is quality newspapers which face heavier costs than any other newspaper in their setting—there is more of it, and it has to be done (*pace* the *Guardian*) to a higher standard.

Looked at like this what do we find at Times Newspapers Ltd? Well, first, that the management tied all these issues together around a knot: a guarantee by the print unions that no *unofficial* disputes would occur; clearly something no union in its right mind would ever agree to deliver. Having forced the main print unions into a corner on this, TNL management were able to shut down the plant as an example of *union* intransigence.

To punish a well-known TV programme: "It's a Lock-out." If it works it will help push *The Times* towards a profit by the oldest device in the old-style bosses' book—labour cutting, the one fixed cost that can, apparently, once more be made variable.

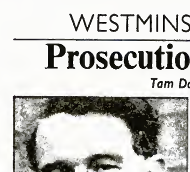
Of course behind the immediate dispute there is a closely linked set of general issues around labour and computer technology. If we stop and think about it, what is happening to *some* employees of *The Times* is going, shortly, to happen to a great many more people and—increasingly—white-collar workers too.

Computers are going through their own industrial revolution. It may transform our lives as decisively as the first industrial revolution did the lives of our great-great grandparents. The real dilemma for the press—and perhaps very shortly, the broadcast media as well—soon aiming at terminal one, is just where traditional crafts, like this one you have just finished perusing, fit in *anywhere*. It is not a comfortable thought. ☐

WESTMINSTER SCENE

Prosecution defended

Tam Dalyell MP



As a *New Scientist* columnist, I have had a significant number of letters, arising out of the case of Regina versus Aubrey, Berry, and Campbell. On the opening day of the New Year in the House, Sam Silkin, the Attorney General, said solidly that "in exercising my discretion under the Official Secrets Act, I have always considered each case on its merits, taking into consideration judicial interpretation of those Acts." Michael Latham, who is as active and tenacious as a young back-bench Opposition MP ought to be, asked a question which has occurred to a great many MPs on both sides of the House during this uneasy affair.

"Could the Attorney General explain how it was in the public interest to sanction charges under the Official Secrets Act, and then withdraw all of them during the course of the trial?" Latham pointed out that the trial judge himself described those charges as inappropriate and oppressive. He observed that the whole case was a disaster for the Attorney General and his office, from start to finish. Sam Silkin, unabashed, retorted that on the evidence available to him when he made his decision, it was perfectly appropriate to bring those charges and to give consent to the bringing of them. However, he added, evidence which comes to light in the course of a case not infrequently changes the view that one takes. MPs interrupted the Attorney on his use of "infrequently" at this juncture, giving vent to the very general feeling that it was a most unusual case.

But, as ever, Sam Silkin stuck to his guns. Why, if cases did not change people's minds, everyone charged would invariably be found guilty! The Attorney then pointed out to the House that he had decided, "in fairness to the defendants" to authorise the withdrawal of charges, which would have required them to prove their innocence. Thereupon, Christopher Price (Lewisham, W) unquestionably one of the toughest-minded and ablest men in the House of Commons, pointedly asked Sam Silkin if he really thought that the cause of the Official Secrets Act was best served by "vast public show trials of this kind". Was he aware that one of the criteria, accepted by many of his own colleagues who were lawyer MPs was "disproportionate public expenditure?" Did the Attorney think that the hundreds of thousands of pounds poured into the pockets of already well-to-do lawyers in this case served a purpose? Price reminded Silkin that on the Gouriet case, he had given the House a full long statement on the reasons for his discretion. Why did he not do so in the case of Aubrey, Berry, and Campbell?

Sam Silkin, far from petulantly, told the House that the case was a matter of national interest, "the disclosure of which could seriously damage national security." At this point, some MPs clearly thought that their credulity was being stretched. The Attorney thought that it was perfectly appropriate that the case should be brought. As he had said, in the course of the case evidence was brought by the defence, and questions were put which caused him to review the matter at a certain stage, and to take a different line on the Section 1 charges. Silkin added that the defendants were convicted on Section 2 charges, and the learned judge, in remarks which he made when sentencing them, clearly indicated that the matters were serious.

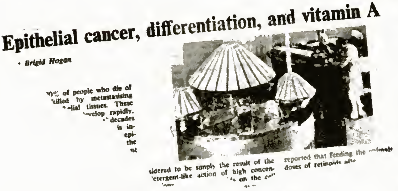
Leon Brittan (Cleveland and Whitby), who in my lay view is one of the very ablest lawyer politicians whom I have seen in 16 years in the Commons, rose. Did Sam Silkin agree that whatever the rights and wrongs of what he has just said, he had got into great difficulties on the case! Brittan then went on to say that the difficulties would not arise in the future if the government was at last to introduce measures to reform the Official Secrets Act. The report suggesting the reform of the Official Secrets Act had been on the shelf for a long time. Was it not time the government did something about it? The Attorney could rightly say that the question of reforming the Official Secrets Act was for the Home Secretary, but even if the Acts had been amended and reformed in accordance with the report of the Franks Committee, and the government's White Paper, this case of Aubrey, Berry, and Campbell would still have been one that it would have been right and proper to bring.

Some MPs think that if the Attorney is really justified in saying this, and we suspect he might well be, thought must be quickly given to variations on Franks. Personally, I go along with Price, that this kind of case raises deep questions of use of public money. With NUPE marching through the streets of London demanding a modest £60 basic for hospital porters, how is it possible in conscience to justify this kind of theatrical trial?

The next step is for sympathetic lawyers to apply their mind to the form of legislation required to avoid repetition of this kind of proceedings. Next time, people will lose patience. ☐

HANDS OFF THE OFFICIAL SECRETS ACT
PEYTON

Feedback



Epithelial cancer, differentiation, and vitamin A

• Brigid Hogan

of people who die of
killed by metastasising
tissues. These
velop rapidly.
decades
is in-
epi-
the
at

sidered to be simply the result of the
detergent-like action of high concen-
on the ce

reported that feeding the animals
doses of retinoids afte

Skin cancer probe shock

Our picture is lifted from the journal *Nature* (Vol 277, p 261), where it appeared without comment recently. It shows, as a sharp-eyed colleague noticed, the Venus multiprobe spacecraft, which completed a highly successful mission a few weeks ago (*New Scientist*, 14 December, p 828).

We are told in the article accompanying the picture that "more than 90 per cent of people who die of cancer are killed by metastasing tumours of epithelial tissues", but are disturbed by this new link between NASA and health.

We know of course, that underarm deodorants destroy the ozone layer, so allowing more ultraviolet rays to rain down on us and cause skin cancer. No mention is made of any connection between cancer and the probe, and we ask what NASA and *Nature* know that we do not. ☐

Whale meat again

Our revelation (Feedback, 11 January) of a test-case importation of whale meat has set the Department of the Environment hot on the trail. The Importer, Jon Barzdo, has been asked to apply for a licence and advised "not to part with the goods until the outcome is decided." DoE also says that it doesn't issue licences for whale meat. But Barzdo may have devoured the goodies; in that case the Department is not yet sure what it would do. ☐

Getting the needle

Viewers of Channel 33 in the United Arab Emirate of Dubai recently had a chance to see censorship in action. Channel 33 was showing a US hospital drama about the conservative reaction of the medical profession to acupuncture. A patient with pains apparently incurable by modern medicine explained that he had been to countless medics with his problem, to no avail. He mentioned that even the Jewish hospital had been unable to cure him. At this point, the film was interrupted and the station's logo flashed onto the screen. The same thing happened again—twice—whenever the patient retailed his complaint against the Jewish hospital. Eventually, the film broke off in mid-stream. I suppose that Arabs watching got the point. ☐

Art for engineering's sake

In these times of shoddy workmanship it's good to see a company taking a pride in its work. One such firm must surely be Barr and Stroud, which turns out precision engineering equipment—including all the Royal Navy's submarine periscopes and the laser sight for the Chieftain tank.

On a recent visit your reporter was much impressed by the rigorous testing to which such equipment is subjected, and he inquired as to the identity of an item which was being baked in an oven for a week. It turned out that the object under test was part of a series of graphics due to be displayed in Dubai as an illustration of Barr and Stroud's work, and the artwork was being subjected to typical Arabian Gulf temperatures to ensure that it would not curl or otherwise deform, thus impairing the company's reputation for excellence. ☐

Lump sums

The Association of Scientific Technical and Managerial Staffs—the scientists' trade union—has sent us a press release telling us that "pay increases totalling over 25 per cent have been awarded to contraceptive pill salesmen employed by Wyeth Laboratories". Is this, we ask, a non-productivity bonus? ☐

Not a million million

The latest case report of the Advertising Standards Authority is a catalogue of complaints, some a little more justified than others. One pedant brought a losing action against the creeping Americanisation of the language, in particular that of our words for numbers. This erstwhile member of the public was peeved because a building society claimed that it had assets of "£7 billion" whereas in fact they only had £7000 million. We have always preferred the US billion, and are gratified to see that the ASA was advised by HM Treasury that £1000 million is indeed £1 billion. Besides, in the fine print the building society had said that they meant £7000 million. If only Mr Public had looked he might not have been so badly upset. ☐

Why bother: 1

British inventors who think they have problems can take solace from a letter recently received in the UK from a patent agent in Banjul, The Gambia. "We herewith return your cheque together with the relevant documents," wrote the agent, who had been asked to file a patent application in his country. "In future please do not send us any job with a deadline date because our policy is first come, first serve." ☐

Why bother: 2

Although, as was clearly the object of the exercise, Philips will now go down in history as the company that put the world's first laser powered video disc system into the shops during 1978, it was a very close shave. Only some two dozen machines were actually available for sale in just three shops in one city, Atlanta, Georgia. Keen Christmas shoppers queued all night but were still disappointed. Almost all the machines were snapped up by representatives of companies competing with Philips in the video disc field. One company with no system of its own under development bought two players, so Heaven knows how many Philips' direct competitors took back to their labs to tear apart. It seems that unsuccessful bona fide customers consoled themselves by buying discs of feature films like Jaws, even though there are unlikely to be any players available for many moons yet. Isn't marketing wonderful. ☐

Numbers game

A few weeks ago calculator suppliers Mountaindene had a number problem that was nothing to do with the problems people work out on its products. The firm's phone number—01 455 9855—was uncannily like the Birmingham number of the Lord Chancellor's prison division. Every Monday morning Mountaindene staff would be rung up by unhappy people demanding to know, among other things when their relatives were going to be released. Mountaindene has now changed its number to 01 455 9823, and should now be trouble free. ☐

Space to travel

Carl Sagan's latest book *Murmurs of Earth,* just out in the US, describes the background to making the famous record-containing messages to extraterrestrials which is now out in space aboard the Voyager probe. One problem concerned a valuable Honeywell picture recorder which had to be flown from its manufacturer to the recording studio in Boulder, Colorado. For safety and speed the recorder was not sent as baggage but was flown on the seat with the passengers.

Recounts Sagan, "It turns out that airlines have difficulty coping with the concept of a seat for a piece of equipment. The solution, we found, was to reserve a seat for an individual named Mr Equipment. Since Mr Equipment was under the age of ten, he was able to fly at half-fare."

Jacqueline du Pré used to book a seat for Mr Stradivarius, though he was presumably too old to qualify for a discount.

Ad astra per bureaucracia. ☐

I DON'T LIKE THIS – A MR. JACKAL ACCOMPANIED BY A MR. BOMB.

Letters

Rocking a hypothesis

Your AAS report "Rocks put back birthdate of life on earth" (11 January, p 75) is replete with the scientific *non sequiturs* which normally accompany any explanation of the hypothesis of chemical evolution and without which that hypothesis becomes demonstrably hypothetical! You say "A soup of simple chemicals became organised to form . . . molecular building blocks of life, something we *know* happened here on Earth and *elsewhere* in the Universe too" (my italics). This is blatant confidence trickery, the victims being your many young readers and others not qualified to judge the issue for themselves. For a start, both the "primordial soup" and the "primordial atmosphere" are totally hypothetical. No one knows whether they ever existed in the form claimed by chemical evolution. In fact there are strong scientific arguments against them which I have detailed elsewhere (*From Nothing to Nature*, Evangelical Press, 1978). The only argument in their favour is the circular reasoning that, without them, chemical evolution could not have occurred. Of course, everyone has the right to his own beliefs about the creation of life (my own happens to be that life was created miraculously by God). What is contrary to the spirit of science is to claim, as does your report, that such beliefs are scientifically established facts. And how do we "know" that life has arisen "elsewhere" in the Universe?

Your report continues with the reminder that "no one has yet built a living organism . . . starting from scratch". True, indeed, but this disarming admission conceals the enormous gap between what synthetic chemistry, with all its skill and knowledge, can make in the laboratory and the great complexity and organisation of the simplest living cell. There exists as yet no remotely plausible explanation of how random chemical process could create the information-packed entity we call a living cell, even given infinite time!

E. H. Andrews London

No name for Prestel

Congratulations to Adrian Hope (18 January, p 177), for demonstrating the weakness, if not outright invalidity of the Post Office's application to gain a registered trade mark for the word "Prestel" for electrical and electronic apparatus because another firm has already used the mark for that sort of equipment. He might also have stressed the fact that under UK registered trade mark law, one cannot get a monopoly right to a mark which is used for services rather than goods. Thus the Post Office has ended up with no monopoly right to the term "Prestel" for its viewdata service, and probably also no monopoly right to the term when used in viewdata equipment.

This is the second time the PO has been lost in the trade mark jungle—the attempt to get a registered trade mark for "Viewdata" ended in failure. Its errors demonstrate the need for doing one's homework carefully before choosing a name by which a product or service will be known.

C. Oppenheim London

No abandonment

Michael Kenward's statement in "Coal gasification goes underground" (11 January, p 91) that "Britain's National Coal Board has all but stopped work on UCG . . ." lacks information on current NCB research and could be misleading.

In 1976/7 the NCB carried out a survey of *in situ* coal conversion techniques which might have application in the future to exploit deep or remote coals or as an alternative to conventional mining. Several potential *in situ* processes were identified and a recommendation to a small team to do detailed scientific technical and economic assessments of the techniques was acted on. A team was set up last year at the NCB's Mining Research and Development Establishment at Stanhope Bretby, Burton-on-Trent.

The monitoring and development of technology and circumstances which could make UCG economically worthwhile and environmentally acceptable in UK conditions is one of the team's responsibilities. The NCB has by no means abandoned research on *in situ* conversion and is, in fact, in the process of considering the feasibility and merits of alternative methods, to be in an informed position and to take a leading role if and when any of the possibilities merit a commercial development.

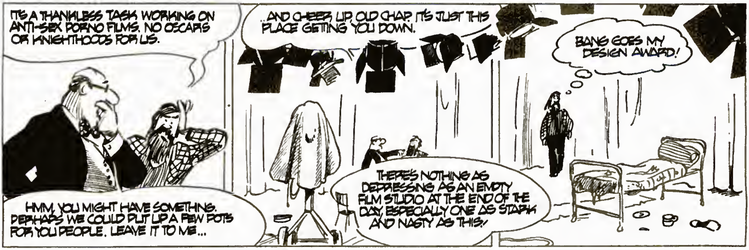
A. C. Bailey
Head of Advanced Mining Unit NCB
Burton-on-Trent

Stupid *and* useless

Leaving aside the privacy aspects of computers, what Colin Tudge has to say (Forum, 11 January, p 108) about the effectiveness of these machines in problems like drug supervision is simply not true. I had hoped that such suggestions died 10 years ago.

It is almost impossible that computer linkage would have picked up the thalidomide problem any earlier. Apart from the fact that no one at that time was terribly aware of the possibilities of teratogenesis, unless the specific abnormality of phocomelia had been coded into the computer, the very tiny pertubation produced by these extra congenital abnormalities would not have been noticed. Practolol is an

Grimbledon Down **Bill Tidy**


IT'S A THANKLESS TASK WORKING ON ANTI-SEX PORNO FILMS. NO OSCARS OR KNIGHTHOODS FOR US.
HMM, YOU MIGHT HAVE SOMETHING. PERHAPS WE COULD PUT UP A FEW POTS FOR YOU PEOPLE. LEAVE IT TO ME...
...AND CHEER UP, OLD CHAP. IT'S JUST THIS PLACE GETTING YOU DOWN.
BANG GOES MY DESIGN AWARD!
THERE'S NOTHING AS DEPRESSING AS AN EMPTY FILM STUDIO AT THE END OF THE DAY, ESPECIALLY ONE AS STARK AND NASTY AS THIS.

Puzzle No. 89

Division: figures all wrong

In the following, obviously incorrect, division sum the pattern is correct, but all the figures are wrong.

```
            2 3
38 ) 2 1 9 2
     2 1 0
     -----
         9 8
         9 4
         ---
```

The correct division comes out exactly. The digits in the *answer* are only 1 out, but all the other digits may be incorrect by any amount.
Find the correct figures. *Eric Emmet*

Solution to Puzzle No. 88

Sergeant Simple in verse

B's figure was wrong. It should be between *25* and *39* inclusive

A v B	1-2 to 9	B v C	9 to 2-1
A v C	1-1	B v D	1-9
A v D	1·9	C v D	1·9

even better example. Spontaneous eye damage due to vascular disease is common in precisely those patients who would be under treatment with Practolol. The most curious and lethal consequence of Practolol therapy, however, was the peritoneal fibrosis which is just about unknown in other circumstances. There would not have been a code for this disease and it would have been missed if we had relied on a computer.

The problem has been, and remains, getting the information from written notes into a form suitable for the computer to handle and this almost invariably is where the disasters arise.

We have already had enough problems with Hospital Activity Analysis, which continues to be an expensive source of inaccurate information, without listening to any further propaganda for what would be a costly business. Unless every GP and hospital doctor is given a computer terminal, the interface will have to be made by lay people. Their training can never be sufficiently rigorous or subtle to make it a worthwhile exercise, and in the present state of decrepitude of the NHS it is not a project that is worth even considering.

The existing method of notification will work very sensitively if people use it properly and it will not give a sense of false security if it is badly used.

P. F. Plumley FRCS *Bexhill-on-Sea*

Support for Laetrile

Your contributor on laetrile ("Houston Report", 11 January, p 88), has not presented an accurate or a balanced report. The denigration of Ernst T. Krebs jun, Andrew McNaughton and John Richardson, who support the use of laetrile, is not worthy of your journal. The politics of these individuals, or their previous or current activities, does not affect the scientific claims made about laetrile.

In the US, Dr Harold W. Manner, professor of biology at Chicago's Loyola University has stated categorically "I have documented case studies of work done with both laboratory animals and human beings which prove that nutrition therapy using laetrile (amygdalin) can cure, contain and prevent cancer". He presented his evidence in 1978 at the annual meeting of the National Health Federation in Chicago, to an audience of over 2000 people and was attacked by the American Medical Association not on the bases of his results, but for presenting his evidence in the wrong place! His successful animal studies used C-3H mice which produce spontaneous tumours. When he attempted to reproduce his results on mice in which cancer was induced (as in the Sloan-Kettering experiments) his results were negative. This has led him to conclude that laetrile acts on the processes within the body that cause and allow the tumour to begin.

Nieper has pointed out that experiments on cell cultures will not be successful because laetrile acts continually on cells of a high respiratory rate. This leads one to state that unless a current National Cancer Institute test of laetrile in the US incorporates a nutritional component which enhances its activity, then results will be negative. Such nutritional methods are being used in Holland, Germany and the UK. These methods, incorporating laetrile, have produced a 40 per cent long term survival rate in ambulant patients with secondary tumours (Nieper's figures). This is in contrast to orthodox figures for such patients who are considered to have less than a five year survival rate!

Examination of the facts about laetrile, discarding propaganda, will show it to be a useful tool in a programme of cancer control.

L. K. Chaitow *Worthing*

Your laetrile coverage impels me to rush into print on its assumption that B17 (laetrile, etc) is a quack remedy. The persistence of the laetrile advocates is quite simply explained. As physicians or patients they have found this material to be effective in the treatment of cancer; as a result they treat the effusions of the Federal Drug Administration with well merited scorn.

That well-known member of the John Birch Society, the American Dr John Richardson, who has published a collection of case histories, states that the effective, intravenous dose of laetrile is 6-9 grams a day and this must be supported by large doses of other vitamins and minerals together with certain dietary restrictions. This regime is tapered off after the first 20 days ending with the patient on an oral maintenance dose of 100 mg a day and a life-long diet.

In view of all this is it any surprise that pro-laetrile physicians condemn trials with smaller doses? Nothing is easier that bungling a trial by incorrect dosage. Your excellent article ("Cancer—a conspiracy of silence", vol 72, p 522), would seem to indicate just how poor the chances of the unfortunate patients are when treated by orthodox methods. The real "quack remedies" are of course surgery, chemotherapy and in particular radiation treatment. Not one of my immediate circle of relatives, friends and colleagues who have contracted cancer have survived under such treatment. More power to the elbows of the laetrile advocates.

Frank Hourigan *Birmingham*

No confidence

Robert Muir Wood describes *Psi Search* (11 January, p 116) as "a catalogue of credulity". Not having read *Psi Search* I am in no position to dispute his judgement; but the example he cites—the authors' acceptance of "decline effect", whereby a psychic's powers "diminish the most closely they are studied"—does not encourage confidence. Has Dr Wood himself ever studied the evidence for decline effect? It is only too easy to imply that the decline of a subject's ability to score significantly above chance in ESP tests is related to the fact that he is being more closely watched; but there are hundreds of examples, many of them provided by sceptics and by investigators with no preconceived notions, where the decline has been observed while the subject is operating within the same protocol.

If he were using some form of deception, the presumption would be that he would maintain or improve his scoring rate. But in the great majority of tests deception is impossible except with the connivance of the investigator. Almost a quarter of a century ago, when there was far less evidence for the reality of ESP, Professor Hans Eysenck remarked that if it did not exist there must be a "gigantic conspiracy" involving "several hundred respected scientists". Is this what Dr Wood believes?

Brian Inglis *London*

Sexism survives

Your unsuspecting report "Attracting women" (11 January, p 77), was a stark example of the crocodile tears

GELS SHOULD HAVE FIGURES AFTER THEIR NAMES, NOT LETTERS
BUSTY JUNK 45-21-31
Bush

shed over the inequality of the sexes in our androcentric society (see AAAS report in the same issue). It is not very convincing to see well meaning, concerned views about the number of women in engineering expressed alongside a cartoon exhibiting the worst sexual stereotypes and sexist attitudes. The contradiction could not have been more powerfully put.

The participants in the parliamentary debate seemed to be groping after solutions without any noticeable analysis or understanding of the actual causes of the problem. (As an aside I might ask if there is any evidence that insisting on students passing 'O' level maths significantly affects either their attitudes towards science or their eventual influence on their pupils?) The real problem, hinted at in the debate but obviously not grasped, lies in peoples attitudes, towards *women*— attitudes very aptly illustrated in the cartoon. On the one hand we have the hollow words of encouragement expressed in the debate while on the other, every social influence yells at young girls something else altogether. The number of women in engineering or any other male stronghold (or vice-versa, of men in predominantly female roles) will not change until the sexist norms and attitudes of our society change.

Lynette Willoughby *Leeds*

Disarmament and environment

Frank Barnaby writing on the prospects for the Conference on Disarmament (Comment, 18 January, p 154), picks out the comprehensive test ban on nuclear weapon tests as particularly important among the next arms control measures.

A comprehensive test ban must include peaceful nuclear explosions (PNE) at the same level as nuclear weapons tests. And it still appears to be the case that the Soviet Union is considering, to put it at its least, the use of PNEs for the earth-shifting required for its massive river reversal programme in Siberia. British and American negotiators are no doubt trying to persuade their Russian counterparts in the negotiations that this earth-shifting would be done just as well by conventional civil engineering methods. The Russians are most unlikely to be persuaded. A three or five year ban on all nuclear explosions, civil as well as military, would conveniently enough, run out at just about the time that they reached the stage of development in the programme where the PNEs would actually be required.

The river reversal programme could have effects far outside the Soviet Union, both in the Arctic Ocean and on the climate of the northern hemisphere. There are welcome reports that President Carter has recently issued an executive order requiring all US agencies to undertake an environmental review of all their actions that might affect the "global commons"—the oceans, the atmosphere, and Antarctica. Is it not now time that such an environmental review and international environmental impact statements should be required of the Soviet Union?

Elizabeth Young *London*

Split beams

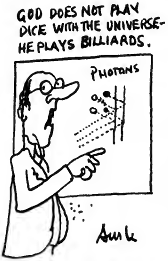
R. M. Helsdon asks (Letters, 18 January, p 195) how photons can split to give an interference pattern. The simple answer must be that light is neither made up of photons/particles nor is it a continuous wave disturbance. The wave and particle models are just models. We use them as long as they make our ideas clearer but must realise that all scientific models have limits. Reality is far more complex (or is it "simple"?) than our mental pictures of it.

Paul A. Crowther *Devon*

In reply to R. M. Helsdon, might I say that photons are fine where they belong, but that one has a devil of a job catching one (thanks to the uncertainty principle). A photon emitted from the gas source may, at a given time, be as likely to be in the next room, next town or Timbuctoo as entering the thin film.

Photons are useful in explaining phenomena at sub-atomic levels. Diffraction, however, is a wave phenomenon. Coherency is a question of whether separate waves are in or out of phase with each other, not a question of whether two photons arrive at the same place at the same time, after being simultaneously emitted from a common source. Such an occurrence would indeed be rare.

Any text book on elementary wave mechanics or the quantum theory will make the relationship between photons and waves perfectly clear. I only regret that, being a chemist and not a physicist, my knowledge of observable light phenomena is insufficient to give a complete answer to Helsdon's query.


GOD DOES NOT PLAY DICE WITH THE UNIVERSE- HE PLAYS BILLIARDS.
PHOTONS
Bush

R. J. Malton *Darlington*

R. M. Helsdon's question lies at the heart of quantum mechanics and I refer him to a lucid discussion of photon interference by P. A. M. Dirac (*Principles of Quantum Mechanics* 4th edition, p 7).

The essence of Dirac's discussion is that each photon is, in a sense, contained in both beams A and B and interferes *with itself*. (Technically each photon is in a state which is a superposition of states associated with A and B separately.) That this is so has been demonstrated experimentally by using a beam so faint that only one photon at a time goes through the apparatus and still an interference pattern is obtained.

D. C. Hodgson *Dorset*

R. M. Helsdon's dilemma is no worse than the more usual one of observing that a particle-like photon cannot very well go through two slits at once, as it apparently does in the two-split experiment. The difficulty is an instance of what J. L. Synge (in *Talking About Relativity*) called the Pygmalion Syndrome: failure to distinguish the mathematical from the physical world.

Both waves and particles are purely mathematical concepts having no physical substance, and light is clearly neither one nor the other. The most profitable way of looking at the problem of interference is this: light energy incident on a film or aperture or grating does not leave the film in all directions, but is concentrated in particular directions only. We cannot say why this should be so, and we may never be able to, but we have developed a way of *predicting* which way it will go. The trick is to associate with each bundle of light a guiding wave—an instruction wave, if you like. This wave, being abstract, can do anything you please; it can suffer a phase change, split itself, diffract, and so on. If, after different bits have gone their separate ways and have been recombined, the "instructions" are self-contradictory, then the energy will not pass that way: and vice-versa.

The main advantage of this theory is that it avoids an even worse paradox than Helsdon's, that the conventional view holds that a diffraction minimum arises from the destructive interference between two waves, each of which is supposed to be carrying energy. But all the energy goes to the diffraction maxima, so it quite clearly never sets off towards the minimum in the first place. So, if wave amplitude is related to the energy being carried, the component waves at the minimum must have had zero amplitude anyway! Of course, this also is more in line with the view one has to take of a probability wave in wave mechanics.

Tony Ayres *Winchester College*

May I offer an "A" level explanation of Mr Helsdon's non-coherent but interfacing light. A set of photons of the same frequency are said to be coherent if their phases are nearly identical. The phase is a numerical quantity whose definition is not needed here. If the photons in a beam of light have their phases distributed over a large range the beam is non-coherent. Despite being non-coherent a beam of light will contain many photons having the same phase. In other words, a non-coherent beam can be regarded as composed of a large set of independent coherent beams.

The interference observed when non-coherent light is reflected from a thin transparent film occurs within each of the coherent sub-beams.

Eric Solomon *London*

I do not think that R. M. Helsdon can be rescued from his dilemma.

Both the wave and the photon particle are incomplete and imperfect models of the reality. The wave model saves the phenomenon of interference but fails to account for the discrete quantum. The particle model saves the quantum but falls down on interference. To find a model which succeeds in both, one must resort to a mathematical abstraction which is above "A" level, and above my level, too.

I do not know just where Helsdon floats, but we lesser mortals just have to go on hopping, ad hoc, from one horn to the other.

W. H. Waring *Lymington*

Gay is great

If Michael Ruse is right (AAAS report, 11 January, p 90), the existence of gay genes has an interesting implication. Since being gay is so clearly disastrous from the point of view of gene survival, the genes in question *must* be linked to other characteristics that bestow some overwhelming biological advantage to make up for it. Gay is not just good—it's better!

Roger Carpenter *Cambridge*

Turd rail?

Having travelled "Inter City" during the recent wintry weather I would like to add to Anne E. W. Hall's letter (11 January, p 115) on train toilets. From the amount of snow lifted from the track by turbulence and seen to pass the train windows, it is evident that whatever is deposited on the track doesn't necessarily stay there.

P. L. Thomas *Weybridge*

No class

Your obscene cartoon on the Feedback page (4 January, p 34) just has no class at all.

Robert R. Shaw *Manchester*

Thanks, Jeremy

Thank you Dr Jeremy Cherfas for your clear explanation of kin selection (4 January, p 31). At last I am able to quantify my feelings towards my cousin. Apparently they are only a quarter of those I have for my brother!

Can I give her this as the scientific explanation of why I forgot her birthday?

Ray Samuels *Kent*

Ozone aired

The article by Thomas Stoel (of the Natural Resource Defence Council, 18 January, p 166), gives an incorrect impression in some areas and is inaccurate in others.

From direct involvement with international work on the CFC/Ozone issue I know that scientists of repute in both France and in the UK were already participating in work on stratospheric problems long before the CFC/Ozone depletion hypothesis was first published. To say that the attitude of the UK and France at Munich arose from a lack of involvement is wrong.

There is a concensus among scientists that the models of the chemistry and dynamics of the stratosphere still contain demonstrated inconsistencies and uncertainties so that numbers produced by the models at any one time must be viewed with caution, and not quoted as fact. One has only to read the full account of the UNEP meeting to see this.

It is not surprising, under the circumstances that the policy makers should not all have come to exactly the same conclusions. This does not mean, as Mr Stoel seems to imply, that they do not all share an equal concern for the environment and are not acting to arrive at a rational overall solution to this global issue.

G. Diprose *Northwich*

Home paper

As the unnamed "international paper company" person referred to by Anthony Hopkinson in his interesting article on small-scale paper-making (vol 80, p 924), I would like to clarify the remarks attributed to me.

First, I am (alas) scarcely an "executive", but merely a scientist—loyal, clear-eyed steadfast, and known to have kissed babies. Second, I rarely issue "lordly rebukes" or have an "attitude of fearful defensiveness", this letter not withstanding. My principal comment in response to Michael Allaby's delightful article two years ago was to suggest that laying out an average office's daily paper supply sheet-by-sheet to dry overnight was to "invite local shambles".

Finally, nowhere did I remark, or even imply, that "paper making needed an enormous volume of water". What I did comment on was the large amount of fibrous effluent (per unit of product) which is generated in hand paper-making.

Mr Hopkinson's small-scale paper making efforts are fascinating, and the developments (or regressions) he describes may be necesary and desirable alternatives for developing countries. However, one thing troubles me. Drying paper made by the conventional "wet-laid" process gobbles up tremendous amounts of energy even on modern paper machines. The "Clacton 1" dries its product by "infra-red heat". How is this heat generated, and how much is used? Can a developing country afford that much energy, particularly when "infra-red heat" usually involves scarce fuels?

J. F. Luce *New York*

More on mirrors

Brian Wall (Letters, 9 November, p 462) wonders why a plane mirror image is "laterally reversed but not vertically". Some letters (23 November, p 632) offer explanations invoking "fore and aft" reversal, although this is not relevant where an object is confined to a plane parallel to the mirror and thus has no fore and aft depth. Yet this case embodies all the essentials of Wall's observations which can therefore be explained with reference to it, as follows.

Suppose an observer initially stands facing an object, and sees it unreversed in any way. If the object is between him and the mirror, to see its reflection he must make it face the mirror by rotating it through 180° about an axis parallel to the mirror. If he is between mirror and object, which are facing each other, he must face the mirror by rotating himself similarly. In either case he produces a lateral reversal of the object from his standpoint if the axis is vertical, and a vertical reversal if the axis is horizontal. The mirror simply reflects whichever reversal he produces; it does not produce any reversal itself.

The reason is found in the case described above where the observer is between mirror and object. Here the ordinary observer persistently rotates about a vertical axis while standing upright (unless he is already standing facing the mirror), so that he persistently sees the resulting lateral reversal. But an acrobatic observer could rotate about a horizontal axis by doing a half-somersault, and then stand on his head to see the vertical reversal not seen by ordinary observers. So the selective behaviour of observers, not mirrors, explains the observations.

Frank Rocke *Sydney, Australia*

. . . and the last word

G. Madgwick (Letters, 11 January, p 115) makes the point that we don't see ourselves as others see us. A favourite party trick played on visiting VIPs by television studio crews is to ask them to comb their hair "in" a television monitor. The results are invariably amusing as they don't realise that the image on the monitor is not "reversed" as in a mirror.

Finally, I was amazed at the deluge of correspondence resulting from my innocent query. My thanks to those who wrote in with constructive comments, I only regret I can't solve the cheese and blunt wire problem, if it exists.

Brian Wall *St Helier, Jersey*

This correspondence is now closed—Ed.

Classified advertisements

Line Rate £1·50 per line
CM Rate £7·25 per single column cm.
Advertisements received by noon Monday will normally be published the following Thursday.
A charge of 50p is made for the use of Box Numbers.

Please send your advertisement to
Classified Advertisement Department,
NEW SCIENTIST,
King's Reach Tower, Stamford Street, London SE1 9LS.
Telegrams: Verditure SE1
Telex: 915748 MAGDIV G

Classified Advertisement Manager.
Eric Nithsdale
tel 01-261 5731
Stan Pinnington
tel 01-261 5798
Advertisement production:
Tim Hartney
tel 01-261 5951

APPOINTMENTS AND SITUATIONS VACANT

Our work in progress could mean real career progression for you!

Bracknell, Berks; Kidsgrove, Staffs £4,000-£8,500

Join the company where exciting things are happening on brand new hardware! Right now we are working on major new Small System developments at Bracknell and Kidsgrove.

This could be your opportunity for real personal career progression. There will be considerable scope for your skills in one of our *integrated* development teams where both hardware and software people have the opportunity to work profitably together or you could find a rewarding future specialising in your chosen field.

Wherever you work you will find every opportunity for fast personal development and this, coupled with our unrivalled reputation for training, adds up to an offer not to be missed.

The successful application of your skills is vital to our total systems development.
That is why we need:

Programmers

with assembler, operating systems development or microcode experience.

Engineers

with a background in state-of-the-art technology.

In both cases we expect you will be in your 20's with at least 2 years experience behind you.

Naturally relocation expenses and full large company benefits are available.

Interested?
Call John Milner on Bracknell (0344) 24842 Ext: 2373 or Peter Mills Ext: 2169 or write to ICL, Lovelace Road, Bracknell, Berks, RG12 4SN quoting reference NS 1173

International Computers
think computers – think ICL

ICL

unilever research

Scientists – Animal Feedstuffs

Due to reorganisation we have the following four vacancies in our Raw Materials and Animal Production Section:

Monogastric Nutritionist (Ref: CH-233M)

The job holder will plan and direct the work programme of a small research team carrying out studies on monogastric metabolism/nutrition with the objective of further understanding the relationships between diet and animal performance. This will include the development of experimental techniques for studying protein metabolism in monogastrics and computer simulation in animal growth.

Candidates should have an honours degree in biochemistry/nutrition with research experience to Ph.D. or similar level in pig or poultry nutrition. Experience in computing would be advantageous.

Ruminant Nutritionist (Ref: CH-234M)

The job holder will plan and direct the work programme of a small research team carrying out studies on ruminant metabolism with the objective of improving utilization of raw materials in feedstuffs.

Candidates should have an honours degree in agricultural science/nutrition with research experience to Ph.D. or similar level in animal nutrition with particular emphasis on ruminants.

Raw Materials Biochemist – Animal Feedstuffs (Ref: CH-235M)

The general area of work is raw materials in support of Unilever's animal feedstuffs business. The work involves evaluation of raw materials and development of methods for improving their nutritive value for use in animal feeds, mainly for ruminants.

Candidates should have an honours degree in biochemistry with research experience to Ph.D. or similar level in plant science, preferably with particular emphasis on protein, carbohydrate or lipid structure and metabolism. An appreciation of farm animal nutrition and experimentation would be useful but not essential.

Nutritional Biochemist – Animal Feedstuffs (Ref: CH-493A)

The general area of work is the exploitation of fats in animal feedstuffs. The research programme covers two main aspects:

(a) The evaluation of fats as energy sources for pigs, poultry and ruminants.

(b) The effects of fats in diets on primary and secondary production characteristics (e.g. carcass composition) of farm species, and their interaction with other dietary components.

Candidates should have a good honours degree or M.Sc. in biochemistry with chemistry and preferably with some experience or knowledge of lipid biochemistry/metabolism.

A good starting salary dependent on qualifications and experience and other Unilever benefits of employment will be offered to the successful candidate.

Please write for an application form and quoting reference number to:

Miss J. Kenny,
Recruitment and Career Development Manager,
Unilever Research,
Colworth Laboratory,
Unilever UK Central Resources Ltd.,
Colworth House, Sharnbrook,
Bedford MK44 1LQ.

UNIVERSITY OF STRATHCLYDE

Department of Biology

ELECTRON MICROSCOPE TECHNICIAN GRADE 5

Applications are invited for the above post in the department of biology which houses an AEI EM6B and a JSM 35 scanning microscope. Proficiency in the operation and routine maintenance of electron microscopes is essential.

The person appointed will be expected to become actively involved in the biological projects currently in progress in the EM laboratory. Minimum qualification HNC or equivalent.

Salary Scale (including all supplements): £3186-£3720 per annum (under review).

Applications in writing, QUOTING REFERENCE B.43, giving details of age, experience and qualifications, should be made to The Personnel Officer, University of Strathclyde, Royal College Building, 204 George Street, Glasgow G1 1XW.

THE UNIVERSITY OF MANCHESTER

Department of Zoology

SRC POSTDOCTORAL RESEARCH ASSOCIATE

Applications are invited for a research post to help in a new project on neuronal variability in the parthenogenetic fish Poecilia formosa. The project has several aspects involving behaviour, embryology, neurophysiology and anatomy, and whilst neurobiologists would be welcome to apply, such a background is not absolutely necessary. The applicant should have completed, or be about to complete a PhD, and be competent in data analysis. The department is well equipped, and work related to the project is being carried out in the department and elsewhere in the university. Salary in the range £4382-£4882. Superannuation. The appointment is tenable for up to 3 years commencing October 1979. Applications including full curriculum vitae and the names of 2 referees should be sent to Professor D. M. Guthrie, Department of Zoology, The University, Manchester M13 9PL, from whom further particulars can be obtained by 15 March. Quote ref: 16/79/NS.

UNIVERSITY OF NOTTINGHAM

School of Agriculture

Sutton Bonington
Loughborough

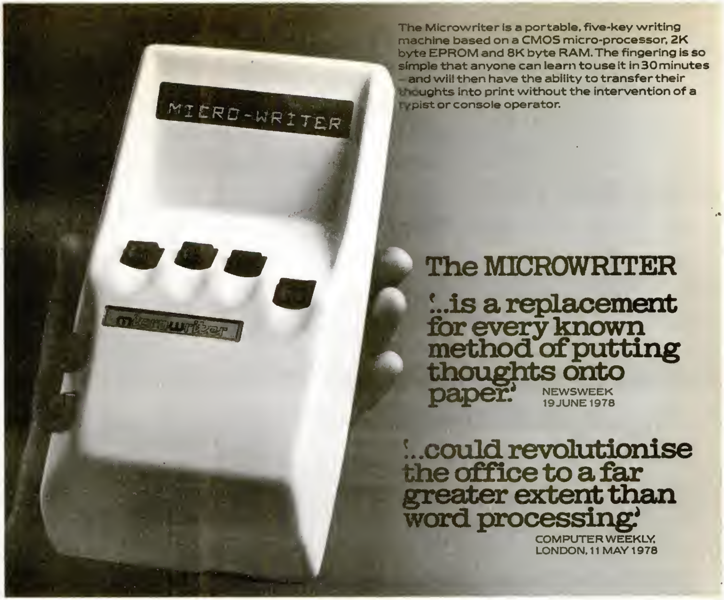
Applications are invited for the post of

TECHNICIAN GRADE 3

within the Animal Production Section of the Department of Agriculture and Horticulture. The successful applicant will be required to assist in studies of the factors controlling reproduction in farm livestock, and the work will largely involve the radioimmunological assay of hormones. Previous experience with such techniques is not essential. The appointee will also be responsible for the day to day running of the appropriate laboratory facilities.

Salary in accordance with Grade 3 for Technicians £2688-£3060 pa.

Write or telephone the Secretary at the School (Tel: Kegworth 2386) for an application form quoting Post Ref. 79/2.



The Microwriter is a portable, five-key writing machine based on a CMOS micro-processor, 2K byte EPROM and 8K byte RAM. The fingering is so simple that anyone can learn to use it in 30 minutes – and will then have the ability to transfer their thoughts into print without the intervention of a typist or console operator.

The MICROWRITER

'...is a replacement for every known method of putting thoughts onto paper.' NEWSWEEK 19 JUNE 1978

'...could revolutionise the office to a far greater extent than word processing.' COMPUTER WEEKLY, LONDON, 11 MAY 1978

MICRO-PROCESSOR ENGINEERS

With the financial backing of Hambro Life Assurance, we are now setting up an organisation to develop and exploit what could well prove to be the most important invention in the field of office equipment since the development of the typewriter.

We are interested in talking to engineers with upwards of three to four years' experience in software/hardware design who would welcome the challenge of working on the development of the many exciting applications of this revolutionary system.

Whilst experience and qualifications are important we are even more interested in applicants' proof of drive and enthusiasm.

Write immediately or 'phone Andy Thomlinson at:
Microwriter Ltd., 7 Old Park Lane, London W1.
Telephone: 01-493 5633.

microwriter

Technician

Drug Metabolism

A vacancy exists for a Technician to work in our Drug Metabolism Department. He/she will assist in determining the metabolic fate of candidate drug compounds in both animals and man. There will also be some involvement in carrying out animal procedures.

Candidates should have O levels, HND or equivalent qualifications. Home Office licences would also be advantageous.

We are part of a large expanding international company in which salaries and job security are of the high standard to be expected.

Benefits include minimum of four weeks holiday, contributory pension scheme with free life insurance, free membership of PPP, flexible working hours, staff restaurant with luncheon vouchers, sports and social club and contribution towards removal expenses where appropriate.

Please write or telephone for an application form to: Adrian Forrest, Personnel Department, Hoechst UK Limited, Walton Manor, Walton, Milton Keynes, Bucks. Tel: Pineham 5068.

Hoechst

Senior Scientist

Electron Microscopy

Rank Xerox, world leaders in the field of electrostatic reprographic systems, require a Senior Scientist to head an Electron Microscopy section at their Engineering Group Headquarters at Welwyn Garden City.

The Section provides extensive technical analytical support to the Company's engineering and manufacturing sections. The facility has an electron probe analyser, one transmission and two scanning electron microscopes with extensive back-up facilities.

Applicants of either sex should be graduates and have considerable direct practical experience in the above techniques, preferably in an analytical service capacity.

A very attractive salary and benefits package will be offered, which includes flexible working hours, four weeks' holiday, free life assurance, pension and sickness schemes, and full relocation assistance will also be given.

Contact Jim Collingham on Welwyn Garden City 35794 or Milton Keynes 312870, for an application form and Company information, or write to him at Rank Xerox Engineering Group, Bessemer Road, Welwyn Garden City, Herts. AL7 1HE.

An answering service is available on 0908-312870.

RANK XEROX
ENGINEERING GROUP

ANIMAL DISEASES RESEARCH ASSOCIATION

Moredun Institute

SCIENTIFIC OFFICER/ HIGHER SCIENTIFIC OFFICER

There is a vacancy in the Pathology Department for a person with experience in cellular immunology to join a team studying mucosal defence mechanisms in sheep. The appointee would also help develop immunohistochemical techniques for the identification of antigens on the cell surface and within tissues. Experience in serological and immunochemical technique would be advantageous. Applicants should have an Ordinary Degree, HNC or equivalent with experience or Hons Degree in an appropriate subject. Five years' relevant post qualifying experience is required for appointment as HSO. Salary scales—SO £2839-£4415, HSO £4101-£5448 with entry according to the qualifications and experience of the successful applicant. Non-contributory superannuation scheme. Applications giving the names of 2 referees should be sent to the Secretary, Animal Diseases Research Association, Moredun Institute, 408 Gilmerton Road, Edinburgh EH17 7JH, from whom further particulars may also be obtained.

THE UNIVERSITY OF LANCASTER

Post-graduate Research Assistant— Environmental Radioactivity

A post-graduate research assistant is required for a three year research project on the transport of artificial radionuclides from the marine to the terrestial environment. The research is supported by a grant from the Natural Environment Research Council to Dr S. R. Aston of the Department of Environmental Sciences. Applicants should have a good honours degree in chemistry, physics or environmental sciences, and experience in radioactive work.

Salary will be on the scale £3884–£4882. Further details may be obtained (quoting reference L105/B) from the Establishment Officer, University House, Lancaster LA1 4YW, to whom applications (five copies) should be sent not later than 16 March, 1979.

MEDICAL RESEARCH COUNCIL

Laboratory Animals Centre

NUTRITIONIST

Scientists with postdoctoral research experience in the nutrition of laboratory animals, farm livestock or poultry are invited to apply for the post of head of the Centre's Nutrition department. The successful applicant will be the focus for all aspects of the Centre's work in this field and will undertake research into the nutritional requirements of laboratory animals leading to general improvements in nutrition with particular emphasis on breeding performance and the lowering of mortality rates. He or she will also provide a comprehensive advisory service to diet manufacturers and users of laboratory animals.

Excellent conditions of service, attracting a salary commensurate with age, qualifications and relevant experience.

Applications, enclosing a full curriculum vitae, should reach the Director, Laboratory Animals Centre, Medical Research Council Laboratories, Woodmansterne Road, Carshalton, Surrey SM5 4EF.

SCIENCE REFERENCE LIBRARY

Research Assistants

... for interesting posts in London:

Scientific and Technological Information (3 posts)
These posts are concerned with either the Biological or Physical Sciences and Technologies in a team involved with the selection and classification of new literature for addition to the library, answering written enquiries and providing a reader reference service. Duties also include participating in educational courses, compiling guides to relevant literature, and maintaining contacts with users of biological sciences (or physical sciences and engineering) literature in other parts of the country.

For the post in **Biological Sciences,** candidates must have a degree in one of the life sciences, with particular specialisation in biochemistry and knowledge of the literature of biochemistry.

For one of the posts in **Physical Sciences,** candidates must have a degree in mathematics or a physical science which includes the study of mathematics, and knowledge of the literature of mathematics. For the second post a degree or equivalent professional qualification in engineering, a technology or physical science, together with knowledge of engineering literature is essential.

For all the above posts, ability to read scientific literature in at least one modern foreign language is essential.

Reader Services Group (2 posts)
One post involves assisting in the provision of the day-to-day running of the reference service to the public, and answering enquiries. Candidates must have a degree in a physical science or technology.

The second post, in the Computer Search Service, is concerned with the biological and medical areas of "on-line" services and includes providing tuition, preparing guides and other explanatory leaflets, and giving public demonstrations. Candidates should preferably have a degree in an appropriate science or technology. Knowledge of chemistry and "on-line" information retrieval experience very desirable.

SALARY: as RA I £4565–£5910 or RA II £3300–£4880. Level of appointment and starting salary according to age, qualifications and experience. Appointments are pensionable and may be permanent or (in appropriate cases) on secondment.

For full details and an application form (to be returned by 1 March, 1979) write to Civil Service Commission, Alencon Link, Basingstoke, Hants RG21 1JB, or telephone Basingstoke (0256) 68551 (answering service operates outside office hours). **Please quote G(3)382.**

THE BRITISH LIBRARY

BL

M.R.C. CLINICAL RESEARCH CENTRE
(Northwick Park Hospital)
Watford Road, Harrow, Middx HA1 3UJ

Technician

required to assist in experiments associated with anaesthetic toxicity. Applicants should hold HNC or science degree. Salary within the range £3615 to £5034 p.a. incl. LW. Application forms from Mrs J. Tucker-Bull. Please quote ref. 101/2/4332. Closing date 22 February, 1979.

BCIRA

ENVIRONMENTAL CONTROL FOR IRONFOUNDRIES

A vacancy exists in the Member and Technical Services Department of BCIRA for a person to study environmental pollution problems in the ironfounding industry.

THE JOB

BCIRA has an extensive programme of research and development on environmental control in ironfoundries. The successful candidate would join an established team of engineers to study environmental pollution problems. The person appointed will be expected to cover a wide field but immediately would be involved in projects concerned with the measurement and control of emissions from melting furnaces and other processes in ironfoundries. Some travel and site testing in foundries is an essential part of the job.

THE PROSPECTS

BCIRA is the largest organisation in the Western World devoted to the technology of iron castings production, and can offer an unequalled insight into the industry and its processes. Many employed at BCIRA in this way have enjoyed considerable subsequent promotion and developed international reputations. Remuneration will be substantial and not less than current salaries in industry, and will be dependent on age, experience and qualifications.

THE QUALIFICATIONS

The successful candidate is likely to have a degree or equivalent in a science or engineering subject, and experience could include any of the following:

Foundry practice;
Pollution control;
Dust and fume control;
Industrial hygiene;

but other candidates who consider themselves to be suitable for this post may also apply. The post requires initiative and a scientific as well as a practical approach to industrial problems. The ability and the willingness to learn and apply new techniques to practical situations are important.

Removal and professional relocation expenses provided when appropriate.

Requests for application forms quoting reference No. MTS/5, in strict confidence, to:

J. T. Radia,
Environmental Group,
Member & Technical Services Department,
BCIRA,
Alvechurch, Birmingham B48 7QB.

SYSTEMS PROGRAMMER

The Daresbury Laboratory, an establishment of the Science Research Council, situated in the north Cheshire countryside is constructing a Nuclear Structure Facility. Known as the NSF, the project is based on a tandem electrostatic accelerator which will be the largest in the world. When completed it will provide a facility of world standard which will attract users from both the national and international science communities.

The NSF machine represents a significant step forward in the technology of this type of accelerator and requires a powerful computer control and monitoring system. It is in fact the first accelerator of its type to be designed with comprehensive integral computer control.

The control system is based on a central Interdata 7/32 computer with up to 10 peripheral Interdata 7/16 computers. A vacancy exists for a Systems Programmer to join a small team of computer professionals designing and producing the software to control this network. Many problems associated with interactive colour displays, plant data handling and the operator interface, made particularly challenging by the distributed nature of the system, remain to be solved and a considerable amount of programming in both high and low level language will be required to complete the system. The post will provide a sound base for a career in computer control systems in general.

Applicants must possess a good honours degree or equivalent and experience in systems programming. The appointment will be made either at Scientific Officer or Higher Scientific Officer level according to qualifications and experience on the following salary scales:

Scientific Officer	**£2,839 to £4,415**
Higher Scientific Officer	**£4,101 to £5,448**

There is a non-contibutory superannuation scheme, a generous leave allowance and a flexible working hours scheme.

Closing Date: 16th February 1979

Write or telephone 0925 65000 Ext. 467, for an application form quoting reference Number DL/644/1/S to:

The Personnel Officer

DARESBURY LABORATORY

Science Research Council
Daresbury, Warrington WA4 4AD

UNIVERSITY OF DUNDEE
DEPARTMENT OF PHARMACOLOGY & THERAPEUTICS

There is a vacancy for a

TECHNICIAN

In the above Department which is situated in the Ninewells Hospital and Medical School. Applicants should have experience of workshop practice, including a working knowledge of electronic equipment, and should possess a Higher National Certificate or equivalent qualification in an appropriate subject, together with extensive relevant practical experience. The work involves the maintenance of equipment, the design and construction of apparatus for use in the research work of the Department, and a supervisory role in the ordering and preparation of material for practical classes.

Salary scale £3186 to £3720 (Grade 5) under review.

Application forms may be obtained from the Establishments Office, The University, Dundee, DD1 4HN and should be returned by 1 March, 1979. Please quote Ref: EST/173/78H.

UNIVERSITY OF OXFORD
Department of Nuclear Physics

RESEARCH ASSISTANT IN ELECTRONICS

We are looking for a young person interested in working with a team constructing a novel electronic detector for use in particle physics experiments at CERN, Geneva. The post, which will involve some opportunity to travel, is for up to three years. Applicants should have a Degree/HND/HNC or equivalent in electronics and some experience of digital/analogue integrated circuit techniques.

Applications (one typed copy) including a statement of qualifications, experience, publications and names of two referees should be sent to **Dr W. W. M. Allison, Nuclear Physics Laboratory, Keble Road, Oxford, OX1 3RH.**

UNIVERSITY OF ASTON IN BIRMINGHAM

Department of Chemistry

CONTRACT RESEARCH OFFICER

A research project has been funded by ECSC and several organisations in the UK to investigate explosive risks of mixing molten iron or steel and water. This work is a continuation of that which was initiated at Aston about five years ago and involves pilot scale experimental work on a remote and protected site.

A position as Contract Research Officer is being established for a period of three years at a salary in the region of £5608 pa to £6080 pa.

The work involves supervising the theoretical and experimental work of a team of about four Technician Operators. Certain aspects of operation, instrumentation, melting, pouring and recording will need improvement or installation.

The work should appeal to someone of proven research ability and used to handling multivariable problems. Ref. No 330/32.

Department of Biological Sciences

FISH NUTRITIONIST

Applications are invited for a Lectureship in Biological Sciences. The successful candidate will be expected to contribute to the teaching of general nutrition and metabolic biology within the Department. Candidates must have research interests in fish nutrition, preferably in the field of vegetable and single cell protein utilisation.

Commencing salary will be within the range £3883 to £5842 pa on a scale rising by annual increments to £7754 pa (under review). Ref. No 331/32.

Application forms and further particulars may be obtained from the Staff Officer (quoting appropriate Ref. No), University of Aston in Birmingham, Gosta Green, Birmingham B4 7ET (Tel: 021-359 3611 Ext 201), to whom applications should be forwarded not later than 23 February, 1979.

MARIE CURIE MEMORIAL FOUNDATION

Cell Biology Unit

Research Assistant or Graduate Technician to work on fundamental aspects of the mechanisms of metastasis. Experience in biochemistry or tumour biology will be an advantage.

Tissue Culture & Cytogenetics Unit

Research Assistant to work on problems associated with mutagenesis/carcinogenesis. Main duties will involve development of systems such as DNA repair, sister chromatid exchanges, etc.

Application forms from Mrs A. Landon, Research Department, The Chart, Oxted, Surrey.

RESEARCH ASSISTANT

Graduate required to join a team of scientists investigating basic aspects of cardiac biochemistry and pharmacology. A training in pharmacology, biochemistry or physiology and an experience in spectrophotometry, tissue metabolite analysis or organ perfusion would be advantageous. The research unit is located in the new Rayne Institute and appointments will be made through St Thomas's Hospital Medical School.

Applications, together with a curriculum vitae, should be sent to Dr Allan Manning, The Myocardial Metabolism Research Laboratories, The Rayne Institute, St Thomas's Hospital, London SE1.

Programmers/Analysts

Exploration Computing

The British National Oil Corporation's increasing involvement in the offshore oil industry has precipitated the largest exploration commitment in the UK Continental Shelf. The Exploration Department is serviced by a dedicated computer installation which includes extensive disk and tape storage, as well as graphic facilities.

To exploit the immense potential of this computer the Corporation is looking for additional expertise in the handling and use of computerised files of geological, geophysical and other information associated with the establishment of an Exploration Database.

Applications are invited from experienced FORTRAN Programmers and particularly from those who are familiar with the storage and retrieval of large files of technical data.

A career with BNOC offers unusually attractive career development opportunities. Salaries and conditions of employment together with relocation expenses, where appropriate, form an attractive package.

If you are interested in one of these posts, please write or telephone for an application form quoting reference PE/KWM to:

The Group Personnel Manager, The British National Oil Corporation, 150 St. Vincent Street, GLASGOW G2 5LJ. Telephone Number: 041 204 2525.

BNOC

The British National Oil Corporation

Archaeological science and conservation

Head of Ancient Monuments Laboratory

£10,500-£11,760

The Ancient Monuments Laboratory, in Savile Row, London, provides scientific support to the DOE's Directorate of Ancient Monuments and Historic Buildings, it is concerned with the scientific evaluation of archaeological sites, and the conservation and evaluation of material which they yield. These sites may be among those in the Department's care of those that are the subject of 'rescue digs' and whose recording prior to destruction is aided by the Department.

The appointment offered carries wide-ranging responsibility for the day-to-day operation and development of the Laboratory as a centre for archaeological science and conservation. It involves management of staff covering biological, chemical and physical sciences, financial control and academic oversight of work contracted to universities, representing the Department on official committees, and liaison with other organisations concerned with archaeological science.

Candidates, preferably aged at least 35, should possess an honours degree in science, and have gained sound practical experience in archaeological science and conservation. Experience in the management of scientists and in supervision of research contracts is desirable.

Appointment as Senior Principal Scientific Officer, with starting salary within the range of £10500-£11760 depending on qualifications or experience.

For further details and an application form (to be returned by 2 March, 1979) write to the Civil Service Commission, Alencon Link, Basingstoke, Hants RG21 1JB, or telephone Basingstoke (0256) 68551 (answering service operates outside office hours). Please quote ref: S/9955/3.

Department of the Environment

LIBRARIAN/ INFORMATION OFFICER

Ciba-Geigy Agrochemicals, a leader in the development and marketing of crop protection, animal health and veterinary ethical products, is looking for a lively person to run the information and library service.

This position involves the cataloguing and dissemination of information, literature searching and the provision of general information relevant to the needs of the business and external bodies. It also includes the lending of reference books, films and photographic slides and the supervision of a part-time assistant.

The successful applicant, aged 26 plus, would be educated to degree standard with an Agricultural/Biological background with some further training/experience in Library information services and systems. The ability to communicate effectively is essential and a knowledge of German would be advantageous.

We can offer an attractive salary, a guaranteed Christmas Bonus, pleasant surroundings, free transport from the local area and other excellent benefits. Relocation assistance can be provided, where appropriate.

If interested, please send a full curriculum vitae, to:

John Hall, Personnel Officer,
Ciba-Geigy Agrochemicals,
Whittlesford,
Cambridge CB2 4QT.
Tel: Cambridge (STD 0223) 833621.

CIBA–GEIGY

PhD ORGANIC SYNTHESIS

A vacancy has arisen within our Medicinal Chemistry Department for a PhD Organic Chemist to undertake the design and synthesis of novel compounds of potential therapeutic interest.

The successful candidate will have experience in organic synthesis probably at post doctoral level and will also possess a sound understanding of the theoretical aspects of organic chemistry and the use of modern physical techniques. Experience in pharmaceutical research would be advantageous.

Conditions of employment include a good pension scheme, life assurance policy, flexible working hours and assistance with relocation expenses where appropriate

**Contact Mr A. B. Johnston,
Fisons Ltd, Pharmaceutical
Division, R & D Laboratories,
Bakewell Road, Loughborough
(Telephone 66361),
Leicestershire, quoting
reference number RD44.**

FISONS
PHARMACEUTICAL DIVISION

UNIVERSITY COLLEGE CARDIFF

Department of Mechanical Engineering & Energy Studies

Applications are invited for two RESEARCH ASSISTANT appointments in the Solar Energy Unit, involving work on the following: (a) control engineering aspects of solar energy utilisation, including system modelling and control strategy; (b) measurement and analysis of solar radiation and development of associated instrumentation.

Candidates should possess at least a good degree in mechanical engineering, applied physics or other appropriate subject. Appointment will be made until June 1980 for post (a) with a salary within the range £3883-£6555 pa and for two years for post (b), salary £3883-£5604 pa (scales under review). Duties may commence as soon as possible.

Applications, giving a brief curriculum vitae and the names and addresses of two referees, should be sent before 23 February to the Vice-Principal (Administration) and Registrar, University College, PO Box 78, Cardiff CF1 1XL. Please quote reference 1691. Further particulars are available on request.

UNIVERSITY OF BRISTOL

WELLCOME COMPARATIVE ANAESTHETIC LABORATORY

Department of Veterinary Surgery

Applications are invited for a

BASIC SCIENTIST

to participate as a Research Assistant in a study of the uptake and distribution of inhaled anaesthetics in large animals. Applicants must have experience of computer programming and modelling.

The appointment is for two years and the starting salary will be up to £3883 per annum. (Scale under review).

Further information can be obtained from, and applications with the names of two referees should be sent to: **Dr B. M. Q. Weaver, Wellcome Comparative Anaesthetic Laboratory, Department of Veterinary Surgery, Langford House, Langford, Bristol BS18 7DU.**

JUNIOR LABORATORY SCIENTIFIC OFFICER

required for one year in the first instance for a research project on the biochemistry of muscular dystrophy supported by a grant from the Muscular Dystrophy Group of Great Britain. The work will involve measurement of enzyme activities and investigations of the properties of cell membranes. Some experience in handling animals is highly desirable. Salary in range £2247 (age 18)-£2904 or £2370-£3015 according to age and qualifications, plus £354 London weighting.

Apply in writing, stating age and giving details of qualifications and experience (if any) to the Secretary, Guy's Hospital Medical School, London Bridge SE1 9RT, quoting Ref. BC.

A MATHEMATICS/ SCIENCE GRADUATE

(or similar) required as a technical sub editor to work on books and journals. A good command of English is essential and experience of publishing would be an advantage, but not essential. Good starting salary. Please write or phone for an application form to J. Henderson Esq, Alden Press (London and Northampton) Ltd, Viatron House, 928 High Road, Finchley N12 9RW. Telephone 01-445 4269/3462.

Computational Fluid Dynamics

Atkins Research and Development wish to appoint a young Engineer or Scientist with an interest in the numerical analysis of flows in the following topics: estuarial hydraulics, dispersion of pollution, flows through pipes and round buildings, boundary layer flows with heat transfer, two-phase flows and fluid-structure interaction. The firm is currently expanding it's consultancy work on structural and fluid dynamic problems associated with civil and offshore structures and nuclear environmental and process engineering and there are also opportunities to participate in research in these subjects.

The appointment would be as part of a team of fluid dynamacists skilled in computational techniques, model testing and large full-scale experiments and there are opportunities for dialogues with structural engineers and designers.

Programming Assistant

The function is primarily to assist in programming new specialist software concerned with fluid and structural dynamics. At present the department is developing graphical display programmes and is involved with extensions to existing software in offshore engineering. The continued expansion of the department's interests ensures work which is broadly in engineering. We wish to appoint a graduate in engineering with an additional interest in computer software, alternatively the successful applicant could well be a science graduate with an interest in engineering computer software.

Ideally he/she will have 1 to 2 years post-graduate experience of FORTRAN programming, preferably in a commercial environment.

Atkins Research and Development are members of the WS Atkins Group, one of the largest integrated consultancies in Europe. It offers good staff benefits and generous assistance with relocation expenses where appropriate.

Please write enclosing cv to Mr JB MacRitchie, Personnel Advisor, Atkins Research and Development, Woodcote Grove, Ashley Road, Epsom, Surrey KT18 5BW.

Or for further information telephone Dr Bruce Dean on Epsom 26140.

Atkins Research and Development

The Queen's Award to Industry to the WS Atkins Group

COMBUSTION RESEARCH AND DEVELOPMENT

... in the field of burner design and gas properties

London up to £8659

The Watson House Research Station of British Gas located in Fulham, offers a senior position for work in the field of combustion and burner design, with responsibility in R&D management. This post demands a high level of technical expertise with ability in leadership and communication skills.

The Group Leader will be responsible for planning and directing the work of a number of scientists and engineers engaged on fundamental and applied studies of conventional and novel burner designs in conjunction with the combustion characteristics of natural and substitute gases. This carries involvement in formulating research programmes and in liaison with British and overseas research bodies and with gas appliance manufacturers.

Applicants, male or female, should hold a good honours degree in Chemistry, Physics or Engineering, preferably with a higher research degree and 5 years' relevant experience.

The appointment will be made within the salary range £7384–£8659 inclusive of Inner London Weighting, plus current self-financing productivity payment.

For application forms, please write to the Administrative Officer, British Gas, Watson House, Peterborough Road, London SW6 3HN, quoting reference WH/860008/105/NS, or phone Mrs White on 01-736 1212 ext 511 during business hours.

BRITISH GAS

ERGONOMIST

Pilkington is an international company and a world leader in glass manufacturing technology. In addition to flat glass there is a wide product range including Triplex safety glass and Fibreglass products. The Head Office is located in St. Helens, Merseyside, close to the M6 within easy distance of the seaside and National Parks.

An Ergonomist, of either sex, is required to join the Ergonomics Section based at Head Office.
The Section provides a service to the five manufacturing divisions and central functions such as engineering design and computer systems design.

The work is varied and mainly concerned with manufacturing operations. Current projects are concerned with process control, machine and workplace design, man-computer interaction, work in hot environments and plant wide human factors surveys.

A degree in ergonomics or closely related subject is essential and relevant experience is desirable. The starting salary, dependent on qualifications and experience, will be not less than £4,000 per annum.

Please write for an application form quoting Ref. P29 to Dr. A. Shuttleworth, Group Recruitment Officer, Pilkington Brothers Limited, Prescot Road, St. Helens, Merseyside, WA10 3TT.

PILKINGTON

Chemical and Mechanical Engineers

(up to £6,215)

The Electricity Supply Industry is looking for four young engineers to contribute to research and development projects on industrial applications, such as drying and heat recovery by means of open and closed cycle heat pumps, advanced electrochemical reactors and processes, and novel methods of metal winning.

Projects are executed by teams of scientists and engineers closely linked to industrial equipment manufacturers, plant contractors and industrial users.

Successful candidates will be expected to fulfill certain functions within existing teams but there is considerable scope both for the development of original ideas and for gaining broad industrial experience.

Appointments will cover the following main areas:-

- **thermodynamics, refrigeration, fluid dynamics**
- **heat and mass transfer processes extraction**
- **plant and process design and control**
- **electrochemical and reactor engineering**

Applications are invited from graduates up to 26 years old with good honours degrees or those who expect to graduate in 1979. Applications from graduates with some industrial experience or those studying for a PhD will be especially welcome.

The posts are based at the Electricity Council Research Centre, Capenhurst, situated in the green belt at the southern end of the Wirral close to Chester and North Wales amenities. The area offers a wide choice of housing.

Starting salaries, dependent on age, qualifications and experience, will be in a range up to a maximum of £6215 (subject to review). Conditions of service include a good contributory pension scheme and relocation assistance where appropriate.

For further information please write giving a full curriculum vitae to: Kevin Boyd, Head of Personnel Services, Electricity Council Research Centre, Capenhurst, Chester, CH1 6ES, quoting ref NS/506.

Electricity
Council Research
Centre

The Queen's University of Belfast

RESEARCH APPOINTMENT

Department of Agricultural Botany

Applications are invited from graduates, preferably with post-graduate experience, to continue a well established programme of breeding in amenity grass species being carried out at the Plant Breeding Station, Loughgall, and aimed at the production of new cultivars tolerant to grass-killing herbicides. The appointment will be initially till 30 September, 1980 but may be renewed. Salary scale (under review) £3384–£6555, initial placing depending on age, qualifications and experience.

Curriculum vitae and the names and addresses of two referees should be sent to the Personnel Officer, The Queen's University of Belfast BT7 1NN, Northern Ireland. Closing date: 26 February, 1979.

IMPERIAL CANCER RESEARCH FUND

COMPUTER PROGRAMMER

required to assist a team of scientists undertaking research in medical genetics.

Initial responsibility will be the development of programs for the analysis of biomedical, clinical and experimental data. At least 2 years experience of Fortran programming is essential and the handling of large scale data files would be an advantage.

Salary range £3936 to £5256.

For further information and application form telephone or write to **Miss S. M. Hurley, Imperial Cancer Research Fund, Lincoln's Inn Fields, London WC2 on 01-242 0200 ext 305.**

LINCOLNSHIRE AREA HEALTH AUTHORITY

Area Medical Physics Department

St George's Hospital, Lincoln

BASIC GRADE PHYSICIST

A vacancy exists for a Basic Grade Physicist due to the promotion of the present holder of the post to another Health Authority.

Applications are invited from graduates in Physics or Engineering for the post which is primarily concerned with electrophysiological measurement techniques and related instrumentation. A good understanding and interest in electronics is, therefore, essential. However, since the department offers a whole range of services it is able to provide the necessary facilities to comply with the present attitudes in the profession to the training of Basic Grade Staff.

Salary will be on the scale £2991 to £4899; the starting point depending upon qualifications and experience. Whitley Council conditions of service apply.

For further details and information about the department please contact Dr P. A. Griffiths, Area Physicist, St George's Hospital, Lincoln. Lincoln 29921, Ext 7122.

Job descriptions and application forms are available from: District Personnel Officer. Lincolnshire Area Health Authority, North Lincolnshire District, 1 St Anne's Road, Lincoln LN2 5RA. Tel: Lincoln 30664, Ext 45. Closing date: 15 February, 1979.

UNIVERSITY OF LONDON KING'S COLLEGE

LECTURESHIPS IN GEOGRAPHY

Applications are invited for appointment to TWO additional lectureships to be provided in the Department of Geography at King's College with effect from 1 October, 1979. Any areas of specialisation will be considered, although duties will involve assistance with quantitative practical classes. The lecturers appointed will be under the age of 30 in order to preserve a balanced age structure among departmental staff.

Salary will be in the range £3883-£7754 per annum (under review), plus £450 per annum London allowance. Universities Superannuation Scheme contributions will be payable.

Application forms and general information on the Department may be obtained by writing to The Assistant Registrar, University of London King's College, Strand, London WC2R 2LS. Applications, in triplicate, including a detailed curriculum vitae, should reach the Assistant Registrar by 1 March, 1979, quoting reference 191656/NSc.

THE ROYAL VETERINARY COLLEGE

(University of London)

Department of Medicine

RESEARCH TECHNICIAN GRADE 4

required to assist with a study of canine chronic pyoderma in a new veterinary dermatological unit, funded for 3 years by the Wellcome Trust. The successful applicant will be required to assist in setting up a laboratory unit and should have a good knowledge and experience of histochemical and immuno-radiological techniques.

Applicants should hold HNC or equivalent relevant qualification. Further details may be obtained by telephoning Mr D. Lloyd, Potters Bar 55486.

Salary scale: £3420 to £3867 pa (inclusive of London allowance) (under review).

Application forms obtainable from Assistant Secretary (Personnel), The Royal Veterinary College, Royal College Street, London NW1 0TU. (01-387 2898 Ext 264.)

Science v. Crime

Opportunities for graduates in Advanced Forensic Investigation.

In the fight against crime, science is an increasingly active agent, in uncovering facts from subtle but often decisive evidence in cases such as murder, rape, arson and burglary. Science can successfully answer the critical questions—"who?", "when?", "where?", "how?" — which provide the police and the courts with invaluable assistance in the maintenance of law and order and the administration of justice.

The Forensic Scientists in the Home Office have access to advanced analytical techniques which, bring to light new sources of evidence. The forensic laboratories at Aldermaston, Birmingham, Bristol, Cardiff, Chorley, Nottingham and Wetherby, (the laboratories at Bristol and Cardiff will move to Chepstow in 1979) are being comprehensively equipped with sophisticated instrumentation for use in gas and high pressure liquid chromatography, mass spectrometry, scanning electron microscopy, electron microprobe analysis, radio immuno assay, atomic absorption spectrophotometry, X-ray fluorescence spectroscopy and other methods.

Work in the Forensic Science Service offers graduates opportunities for advanced scientific investigation associated directly with criminal investigation—often involving visits to the scene of the crime and giving evidence at court.

There are openings for honours graduates (including those qualifying in 1979) in chemistry, biochemistry, biology, pharmacy, physics, materials science and related scientific disciplines, and encouragement will be given to obtain further qualifications. Appointment as Scientific Officer (£2840—£4410) or Higher Scientific Officer (£4100—£5450), according to qualifications and experience. Good colour vision is essential.

For further details and an application form (to be returned by 19 February 1979) write to Civil Service Commission, Alencon Link, Basingstoke, Hants, RG21 1JB, or telephone Basingstoke (0256) 68551 (answering service operates outside office hours). *Please quote ref*: *SY/22/LA/1*

Computer Scientists for industry

No-Honestly-It isn't a contradiction in terms-We DO want them

We have ever such a hush-hush project. Well, actually we have a few. But for this one in particular we are looking for men and women experienced in:–

- Language Design
- Compilers and Translators
- Data-base Organisation and Management
- Theoretical aspects of Systems Analysis and Decomposition

If you prefer to keep fingers in all these pies then so much the better.

Call Peter Chin on 01-953 2030 Extension 3239 for further details or write to

H. E. Batchelder,
Marconi Avionics Ltd,
Elstree Way,
Borehamwood,
Herts.
Quote ref MA 78094

MARCONI AVIONICS
A GEC-Marconi Electronics Company

Mathematician/Physicist

to join a specialist research team

DATA PROCESSING

Seismograph Service has a history of enterprise and technical achievement in one of the toughest of all businesses – seismic exploration in search of the world's natural wealth. Over land and sea, our crews seek out valuable reserves of oil, gas and minerals, collecting essential data to be processed at our Keston, Kent Headquarters.

We're now looking for a man or woman with a specialist background in communication theory (covering signal processing, wave theory and deconvolution) to join our Research Department at Keston. A vital aspect of our entire operation, the Department provides a complete development service – generating new concepts and techniques for use in data acquisition, analysis and processing. Working as part of a small team, you'll be involved in the total Research/Development activity, liaising closely with Data Processing Units.

Qualified to degree level in Physics, you'll have around 4 years experience in communication theory – possibly gained in postgraduate research.

We're offering a competitive salary together with a wide range of large company benefits, including annual bonus and assistance with relocation where necessary.

Please telephone or write, giving brief career details to:

Margot McArthur, Personnel Officer,
Seismograph Service (England) Limited,
Holwood, Keston, Kent BR2 6HD.
Tel: Farnborough (Kent) 53355.

Morgan

OPPORTUNITIES IN MATERIALS SCIENCE/ CERAMICS/REFRACTORIES

Morgan Thermic Limited, a research Company in the multinational Morgan Crucible Group is expanding its research function.

Professional scientists are required with a knowledge of solid state physics and chemistry as relevant to the formation, properties and performance of refractories and ceramics. We are seeking staff who are able to apply scientific principles to assist in the solution of real and practical problems. Considerable experience could be an advantage in that certain of the vacancies demand the ability to manage work programmes and their related staff. However, the management skills must not be at the expense of scientific professionalism.

The positions should appeal to those who have a desire to stay in an R&D environment, but rise to the challenge of the pressures and short time scales required in the innovation of commercially viable products and processes.

These are not desk jobs.

The salaries offered will reflect the importance we attach to these key positions.

Please apply in writing, giving details of qualifications, experience and current salary to:—
Dr C. F. Cooper, Morgan Thermic Limited, Bewdley Road, Stourport-on-Severn, Worcs. DY13 8QR

UNIVERSITY OF OXFORD

DEPARTMENT OF ENGINEERING SCIENCE

Vacancies exist in the Cryogenic Engineering Group for

RESEARCH ASSISTANTS

postdoctoral or graduate in engineering, physics or mathematics

RESEARCH STUDENTS

TECHNICIANS

to work on the following projects:

1. Liquid helium cooling of rotating superconductive machinery. This work forms part of an SRC co-ordinated national programme.
2. Design of a force balance for use in the proposed European Cryogenic wind tunnel. This work will be carried out in conjunction with RAE Farnborough and the European Transonic Tunnel design team.
3. Study of flow-boiling in cryogenic fluids with particular reference to plate-fin heat exchangers. Work will include liaison with HTFS Harwell and industry.
4. Development of miniature refrigerators for use in space.

Applications, with curriculum vitae and names of two referees should be sent to Dr C. A. Bailey, Department of Engineering Science, Parks Road, Oxford OX1 3PJ.

UNIVERSITY OF LIVERPOOL

Department of Biochemistry

Applications are invited from PhD graduates in Biochemistry with experience in protein or membrane biochemistry for the post of

POSTDOCTORAL RESEARCH ASSISTANT

to work on a project financed by the SRC entitled 'Isolation and characterisation of adenine nucleotide transporters of yeast mutant mitochondria.' The work will involve protein purification, protein structure determination on examination of transport function in reconstituted proteoliposomes. The appointment will be tenable for up to two years from 1 June, 1979, as soon as can be arranged.

Initial salary either £3883 or £4133 per annum.

Applications, together with the names of two referees, should be received not later than 26 February, 1979, by The Registrar, The University, PO Box 147, Liverpool L69 3BX, from whom further particulars may be obtained. Quote Ref. 471/NS.

CENTRAL BIRMINGHAM HEALTH DISTRICT

Birmingham Maternity Hospital

Infant Development Unit

CYTOGENETICIST (PRINCIPAL BIOCHEMIST GRADE)

(£6999-£9177)

Applications are invited for this new post of Principal Grade Cytogeneticist. The laboratory offers a full range of cytogenetic investigation and has Regional as well as District commitments. The appointee will be responsible to the Consultant Pathologist for the organisation of work within the laboratory, quality control and the introduction of new techniques. Applicants should hold a relevant science degree and be fully experienced in the field of Cytogenetics.

Visits to the laboratory may be arranged by appointment with Dr Cameron, Tel: 021-454 4851 ext. 224 (Children's Hospital).

Application forms and job description from Personnel Officer, Birmingham Maternity Hospital. Birmingham B15 2TG. Tel: 021-472 1377.

BEDFORD COLLEGE (University of London)

Department of Geography

A LABORATORY TECHNICIAN (GRADE 6)

is required to take charge of the physical geography laboratories of the Department of Geography.

Applicants qualified in analytical chemistry with experience in the preparation and analysis of soil, rock and plant samples, in a wide range of techniques, is essential.

Salary range (under review) £3654-£4365 pa plus £465 pa London Weighting. Application forms, to be received by 22 February, 1979, are obtainable from Senior Assistant Secretary (Personnel), Bedford College, Regent's Park, London NW1 4NS. Tel: 01-486 4400 Ext 312.

UNIVERSITY OF LONDON

Institute of Neurology

MEDICAL LABORATORY SCIENTIFIC OFFICER

to characterise normal and dystrophic plasma membranes using a combination of immunological and biochemical techniques. Salary £3261+£354 London weighting pa. Send details of experience plus names of two referees to Dr F. Walsh, Institute of Neurology, National Hospital, Queen Square. London WC1N 3BG.

free university
amsterdam

The **Faculty of Mathematics and Natural Sciences,** experiments with an advanced teaching programme on "contemporary problems in the present relation between science and society, of which the results may be relevant to problems of science policy."

The teaching focusses on energy problems. Physical and Chemical expertise is given by the respective departments. There is a vacancy for a specialist on social and economic aspects of the energy problems, within the **Unit for the History and Social Aspects of Science:**

lecturer

(up to 31 December 1980)

Task:

- teaching social and economic aspects of the energy problem
- maintaining contacts with the science departments.

Requirements:

- expertness in socio-economic aspects of the energy problems
- research experience and publications
- teaching ability in this field.

The Vrije Universiteit is a fully state-supported university with a Christian foundation: candidates are expected to indicate their willingness to respect, and work in the spirit of the Christian character of the university.

Salary between Dfl. 48.000 and 85.000. Applicant may start immediately. Information on the content of the teaching programme will be given by prof.dr. E. Boeker, tel. 020 - 548 47 36.

All further information will be given by the chairman of the Unit, prof.dr. M.J.S. Rudwick, tel. 020 - 548 29 86.

Written applications with curriculum vitae, list of publications and 2 references should be sent to dienst Personeelszaken van de Vrije Universiteit, Postbus 7161, 1007 MC Amsterdam, vacancy nr. 380-0019.

UNIVERSITY OF EDINBURGH
DEPARTMENT OF
FIRE SAFETY ENGINEERING

Lecturer in Fire Protection Systems

Applications are invited for the above post. Applicants should have a good degree, preferably in Engineering. The appointment will be for 5 years in the first instance. Salary on the scale £3,883—£7,754 p.a.

Further particulars may be obtained from Professor D J Rasbash, Department of Fire Safety Engineering, King's Buildings, Edinburgh, EH9 3JL. Tel: 031-667 1081 ext 3616.

Applications in writing, including the names of two referees, should be sent to **The Secretary to the University, Old College, South Bridge, Edinburgh EH8 9YL, not later than 5 March, 1979.** Please quote Reference 1085.

INFORMATION OFFICER

To be responsible for running the Information Department of an international organisation promoting the use of zinc, lead and cadmium. Duties include dealing with technical enquiries, literature searches, compilation of bibliographies, scanning, abstracting and editing 3 abstract journals. On-line searching is used.

Applicants should be science graduates with experience in information work. Salary according to age and experience.

Please apply with CV to: **F. C. Porter, Zinc Development Association, 34 Berkeley Square, London W1X 6AJ.**

UNIVERSITY OF SHEFFIELD

TECHNICIAN
(GRADE 3)

required for the Department of Biochemistry. The person appointed will assist in research under Professor P. M. Harrison on the structure and function of the iron-storage protein ferritin. The work includes the isolation and analysis of protein ferritin from animal tissues by biochemical techniques and assistance in the X-ray crystallographic analysis of ferritin structure (molecular model building, drawing of maps, computation, photography). Assistance in the preparation of some laboratory classes is also expected.

Minimum qualifications: O.N.C. in Applied Biology and/or Chemistry.

Salary on scale £2688—£3060 p.a. (under review).

Please write to the Administrative Officer (Personnel), (Ref S1145/NS) The University, Sheffield S10 2TN.

Copyrighted material

unilever research

Process Development in the Food Industries

We are the largest Food R & D centre in Western Europe servicing Unilever companies in the U.K. (e.g. Batchelors, Birds-Eye, Walls and Van den Berghs) and abroad.

We have vacancies for Process Development assistants at our central Bedford Laboratory and at our Aberdeen Laboratory. The assistants will work in small multi-disciplinary project teams and cover the development of new processes from the initial feasibility studies to plant installation and commissioning.

Candidates should have a degree in Chemical Engineering or a similar applied Science.

A good starting salary dependent on qualifications and experience and other Unilever benefits of employment will be offered to the successful candidates.

Please write or telephone for an application form, quoting reference CH-482A to:

Miss J. Kenny,
Recruitment and Career
Development Manager,
Unilever Research,
Colworth Laboratory,
Unilever UK Central Resources Ltd.,
Colworth House, Sharnbrook,
Bedford, MK44 1LQ.
Tel. Bedford 781781 Ext. 653

St. Mary's Hospital Medical School
(University of London)
Paddington London W2 1PG

RESEARCH ASSISTANT

required in Department of Biochemistry. Applicants should be graduates or equivalant, having a good honours degree in Biochemistry or Molecular Biology, or related technical experience—restriction enzyme purification or research with plasmids would be particularly useful. Post funded for up to 3 years to assist large and active research group studying human genetic disease using recombinant DNA techniques. Appointment from 1 April or soon thereafter but post could be held for an exceptional graduate until 1 July. Commencing salary, for Research Assistant, within scale £3384/£4382 pa plus £450 p.a. London Allowance (under review). Further details from Professor R. Williamson. Apply with full curriculum vitae and names of two referees to, The School Secretary at above address not later than and February quoting Ref B/RA/NS.

BEDFORD COLLEGE

(University of London)

Histologist

TECHNICIAN (GRADE 5)

required in the Department of Zoology to assist in the research of Academic Staff both with routine histology and the preparation of materials for electron microscopy. The person appointed will be expected to assist with undergraduate practical classes and postgraduates requiring instruction in histological techniques. Previous experience is essential.

Salary range (under review) £3186 to £3720 per annum plus £465 pa London Weighting. 25 days annual leave plus statutory holidays. Season ticket loan scheme.

Application forms available from the Senior Assistant Secretary (Personnel), Bedford College, Regent's Park, London NW1 4NS. (Tel: 01-486 4400 Ext 312.)

ICI

A vacancy exists for a

PHYSICAL CHEMIST

within the Colloid Science Group at ICI's Corporate Laboratory, Runcorn

The successful applicant will join a team of Colloid/Polymer Chemists carrying out experimental work on the preparation and properties of aqueous dispersions and novel dispersants. Ideally, applicants should be in their twenties and possess a degree or equivalent in chemistry. Experience in relevant physico-chemico techniques is desirable but not essential.

The Company offers an attractive salary, together with other benefits including removal assistance, profit-sharing and pension schemes.

If you are interested in this post please write, including full curriculum vitae to:—

Mrs C. Gleave
Personnel Assistant
ICI Corporate Laboratory
PO Box 11, The Heath
RUNCORN, Cheshire

THE UNIVERSITY OF LEEDS

DEPARTMENT OF FOOD SCIENCE

Applications are invited for a temporary post of RESEARCH FELLOW in the above Department. Applicants should have a Ph.D. degree, preferably in biochemistry or chemistry, and have an interest in applying their knowledge to the biochemistry of foods or to the chemistry of food additives. The successful applicant will have opportunities to co-operate with research institutes and to help with departmental teaching. The appointment will be made for a fixed period of three years.

Salary on the IA scale for Research and Analogous Staff (£3883—£6555) (under review) according to age, qualifications and experience.

Interested persons who wish to discuss the post in more detail or visit the Department should contact Professor David S. Robinson (0532-31751 ext. 540).

Application forms and further particulars may be obtained from the Registrar, The University, Leeds LS2 9JT, quoting reference number 72/3E. Closing date for applications 16 March, 1979.

UNIVERSITY OF MANCHESTER

Departments of Botany and Zoology

SENIOR DEMONSTRATOR IN BIOLOGY

Applications invited from persons with a PhD or good honours degree in one of the biological sciences and an interest in biological education. The main duties will be to co-operate in the organisation and development of 1st and 2nd year laboratory classes in Cell Biology, Cell Physiology, Genetics, Ecology and Data Analysis. Facilities for part-time research will be available. The appointment is for three years, commencing October 1979, and may be renewed for a second three-year period. Initial salary within the range £3883-£4631 pa. Superannuation. Particulars and application forms (returnable by 20 March) from the Registrar, The University, Manchester M13 9PL. Quote ref: 18/79/NS.

UNIVERSITY OF OXFORD

UNIVERSITY LECTURESHIP IN ZOOLOGY

Applications are invited for the above post from candidates in the field of comparative physiology. Stipend according to age on the scale £3883-£8257 pa. The successful candidate may be offered a tutorial fellowship at St Hugh's College (open to men and women). Further details of both posts may be obtained from the Acting Head of Department, Department of Zoology, South Parks Road, Oxford OX1 3PS, to whom completed applications (nine typed copies, one from overseas candidates) including the names of three referees should be sent by 9 March, 1979.

ST THOMAS' HOSPITAL

London SE1

BASIC GRADE PHYSICIST

For work on the clinical uses of ionising radiation. Candidates should have a good honours degree in Physics or a related science and, preferably, some relevant experience.

Starting salary in the range £3840-£5253 pa (inclusive) depending on qualifications and experience.

Contact Personnel Officer (01) 928 9292 Ext 2779 for job description and application form.

MATHEMATICIAN or PHYSICIST

to work in

UNDERWATER TECHNOLOGY

An opportunity exists at our Weymouth facility to join an enthusiastic and growing team which is working on new applications of advanced underwater technology.

The main activities in this new position will be:

- Determination of sensor performance in the water environment.
- Underwater detection and classification problems.
- Sensor design (acoustic, magnetic, pressure).
- General Oceanographic studies.

Suitable candidates will have a degree in Physics, Mathematics or Oceanography. Experience in underwater acoustics or the fluid environment is preferred.

Sperry Gyroscope design and develop a wide variety of underwater systems in a friendly and creative environment. Our employment package includes competitive salaries, training opportunities, and generous relocation assistance.

If you are interested, please send brief details to the Technical Manager or phone or write requesting further information and quoting reference UWT04 to:

SPERRY
GYROSCOPE
GRANBY INDUSTRIAL ESTATE,
WEYMOUTH.
TEL: WEYMOUTH 74661.
DIVISION OF SPERRY RAND LIMITED

An

Assistant Editor

is required for

Big Farm Management

the leading monthly magazine for the country's top farmers. Main requirements are an all round knowledge of farming, and feature writing experience. Alternatively, this could provide an opportunity for a young graduate, with a farming background, to make a career in agricultural journalism. Men and women, for an application form please contact:

Personnel Services Department,
Northwood Publications Ltd.,
Elm House,
10–16 Elm Street,
London WC1.
Tel: 01-278 2345 ext. 33.

CENTRAL ELECTRICITY GENERATING BOARD

RESEARCH DIVISION
BERKELEY NUCLEAR LABORATORIES

ASSISTANT TECHNICAL OFFICERS

Berkeley Nuclear Laboratories are situated on the banks of the River Severn midway between Gloucester and Bristol. Vacancies detailed below exist for Assistant Technical Officers in the Fuel and Core Division.

Ceramic Properties Section—Ref: BNL/1/79

The successful applicant will join a group of Research Officers. Duties of the post will include the setting up and running of laboratory experiments using high temperature equipment and controlled atmospheres.

The person appointed will also be required to prepare and examine small samples of materials using optical and electron microscopes. The materials will include specimens obtained from ceramic fuels both before and after irradiation in a nuclear reactor. The handling of small amounts of irradiated material involves special techniques which form an essential part of the job.

Some previous laboratory experience is desirable.

Shielded Area—Ref: BNL/4/79

The successful applicant will join a team engaged in the metallographic examination of irradiated fuel. The work will involve the routine preparation of fuel specimens but there will also be opportunities to assist with the development of new equipment and techniques.

Other duties of the post will include the maintenance of the remote handling facilities, and for this work the job holder may be required to wear airline suits, respirators, etc.

Fuel and Component Properties Section—Ref: BNL/5/79

The successful applicant will join a team responsible for monitoring the performance of fuel elements from the Board's Magnox Nuclear Power Stations, and will be concerned largely with the analysis and interpretation of data obtained from the examination of irradiated fuel elements.

Some familiarity with statistical techniques and computing is desirable.

While it would be preferable for candidates to possess formal qualifications to a minimum of ONC or equivalent applications from those with sound background in the relevant fields of work will be given equal consideration.

Salary will be in the range £3570–£5375 per annum plus a Self-Financing Productivity Payment.

Applications in writing should be forwarded to the **Personnel Officer, Berkeley Nuclear Laboratories, Berkeley, Gloucestershire GL13 9PB** by not later than 3 weeks after date of publication, quoting the relevant vacancy number.

NUTRITIONIST

Directly responsible to the Sales Director the Nutritionist will advise on ration specifications and raw material evaluation. Regular duties will involve liaison with Field, Laboratory and Formulation Management.

As training of Field Staff and negotiations with large customers form an essential part of the role, an ability to communicate effectively will be an important prerequisite.

Applications are now invited from candidates possessing a postgraduate qualification in Animal Nutrition, and ideally having had pig and/or broiler experience.

This challenging new position offers an attractive starting salary and those conditions usually associated with a Unilever Company.

Applications in the first instance should be addressed to:

Mr J. J. Hutchinson, Personnel Manager

BOCM SILCOCK [N.I.] LTD

35/39 York Road Belfast BT15 3GN, Telephone 747321

Job finding couldn't be easier!

With many leading companies using our specialised service to find qualified people, we have access to some of the best jobs that are not even advertised.

Our service is confidential and costs you nothing. So send in the coupon and we'll send you details of our service.

Tick appropriate discipline ☐ Clinical Trials ☐ Information/Drug Registration ☐ R&D
☐ Sales & Marketing ☐ Production
Salary Required ☐ £3,000—£4,500 ☐ £5,000—£6,000 ☐ £7,000 Plus
In Pharmaceuticals Diagnostic Reagents or Scientific Instruments
Please send me details of your specialised service

NAME
Address
Tel. No. CURRENT POSITION

Scientific Staff Consultants
50 Lincolns Inn Fields
London WC2
or telephone Janette Eames on 01-831 6471 or 242 4266 (Direct)

UNIVERSITY OF SOUTHAMPTON

Neurophysiology Research Group

Applications are invited for a

TECHNICAL APPOINTMENT

in the School of Biochemical and Physiological Sciences to assist in a current research project in Mammalian Neurophysiology and Neuropharmacology.

Applicants should possess an appropriate science qualification, at least ONC or two science A level passes, and have relevant experience. Applications from graduates in Physiology and Pharmacology would be welcome.

The appointment which is to be filled as soon as possible, and is for one year in the first instance with the possibility of an extension for a further two years, will be made on salary scale £2688-£3060 per annum (under review), with initial salary up to £2835. Opportunities for further study would include part-time registration for a higher degree if appropriate.

Applications stating date of birth, qualifications and experience and the names and addresses of two referees, should be sent to Mr C. N. Saull, The University, Southampton SO9 5NH, quoting reference number 517/T/NSc.

COVENTRY AREA HEALTH AUTHORITY

Haematology/Blood Bank

Applications are invited from suitably qualified personnel (HNC/Degree) for

MEDICAL LABORATORY SCIENTIFIC OFFICERS

in the above department. The Blood Bank is situated at Walsgrave Hospital and Haematology at Coventry and Warwickshire Hospital.

The posts are ideal for candidates studying for FIMLS.

Further details from T. K. Morris, Principal MLSO, Haematology Department, Coventry and Warwickshire Hospital. Coventry 24055 ext 502.

Applications quoting ref NS in writing and naming two referees to Sector Administrator, Coventry and Warwickshire Hospital, Stoney Stanton Road, Coventry.

THE UNIVERSITY OF SHEFFIELD

Department of Building Science

RESEARCH ASSISTANT (RANGE 1A) IN BUILDING ACOUSTICS

To work on SRC project concerned with sound radiation from buildings. Applications from men and women who should have experimental and/or theoretical experience in acoustics or a related subject. Salary up to £4631 a year. Tenable for two years from 1 April, 1979, or as soon as possible thereafter. Particulars from the Registrar and Secretary, the University, Sheffield S10 2TN, who should receive applications by 16 February, 1979. Quote ref: R245/H.

ANALYST TECHNICIAN (GRADE 6)

required for Department of Geology, University of Reading. Preference given to applicants experienced in wet chemical methods for silicate analysis, but those with substantial experience in general inorganic analysis by atomic absorption and AutoAnalyser techniques also considered. Salary according to qualification and experience in range £3654-£4365 pa (under review). Further details under Ref TS7 9A, from Assistant Bursar (Personnel), University of Reading. Whiteknights, Reading RG6 2AH.

The Institution of Electrical Engineers

Engineers and Physicists as Information Specialists

INSPEC is the leading international information Service covering Physics and Engineering and is continuing to expand and develop in this fast-growing field. A wide range of printed and computer-generated service is supported by a strong programme of product development and research into new techniques for information storage, retrieval and dissemination.

We are seeking both recent and experienced graduates or equivalent in physics, electrical, electronic, computer or control engineering who are interested in a career in scientific and technical information to join our team of information scientists who carry out the selecting, abstracting, indexing and classification of scientific papers for input to our computer database. Opportunities exist for specialisation in a particular field of interest. We should also like to hear from applicants with degree level qualifications in metallurgy. Starting salaries are negotiable and will not be less than £3300 per annum for graduates seeking their first appointment. Full training is given and salaries are reviewed after completion of training (normally 6 months). We offer excellent conditions including four weeks' annual holiday, and flexible working hours in our pleasant new offices at Hitchin, Herts.

If you would like to know more about the possibility of joining INSPEC please write to:

Mr P. Clague
The Institution of Electrical Engineers,
Station House, Nightingale Road,
Hitchin, Hertfordshire SG5 1RJ.

THE INSTITUTION
OF ELECTRICAL
ENGINEERS

IEE

DEPARTMENT OF MATERIALS

POLYMER RESEARCH

The Department has the following vacancies:-

(a) Project Leader
(b) Research Officers
(c) Research Assistants

The successful applicants will work on a variety of problems related to the fabrication and properties of engineering plastics, in close co-operation with sponsoring industrial organisations. Applicants for posts (a) and (b) should have R&D experience in physics, mechanical engineering, polymer/materials technology, or related subjects. Research assistants need no such experience and will have the opportunity to work for a higher degree.

Salaries will be in the range (currently under revision) £3189 to £6900 according to age and experience. Superannuation on USS.

CIT
CRANFIELD INSTITUTE OF TECHNOLOGY
ADVANCED TEACHING + APPLIED RESEARCH

For further information contact
Mrs J. E. Grey
Departmental Secretary
Materials Department
Cranfield Institute of Technology
Cranfield
Bedford MK43 0AL
Tel: 0234 750111 Ext. 324

Technical Manager

Dartford, Kent

The Wiggins Teape Group is seeking a Technical Manager for one of its largest paper mills, which has an output of 75,000 tonnes per annum and covers a wide range of high grade printing, packaging and industrial papers. As part of an £8m capital development programme, Coated Idem Carbonless Copy Paper will be added to this range.

The Technical Manager will be a key member of the mill management team and will be responsible for a department of 80 people, giving a full technical service to the mill and associated marketing departments. Product development is a vital aspect of the job, which also controls process development, quality assurance, mill laboratory services and process control engineering.

A degree or equivalent in Science or Engineering is essential and candidates must be able to demonstrate a record of successful management of scientific work in a production environment. They should be fully conversant with technical aspects of the paper-making process and, ideally, should have had some exposure to industrial relations.

The position, open to both men and women, commands an attractive salary and the usual fringe benefits associated with a large company.

Please write in the first instance, with a brief curriculum vitae, to:

R. J. Kendal,
Group Manpower Planning Adviser,
Wiggins Teape Limited,
Gateway House, Basing View,
Basingstoke, Hampshire RG21 2EE.

Wiggins Teape Limited

MICROPORE INTERNATIONAL LIMITED
Hadzor Hall
Hadzor
DROITWICH
Worcs.

RESEARCH ASSISTANT

Micropore International Limited, manufacturers of MICROTHERM high temperature thermal insulation and CERAMASPEED high performance heaters for ceramic cooking appliances, require a young graduate engineer or scientist to assist in development of new products with worldwide application in the electric appliance industry.

Applicants should have a good honours degree in engineering or physics with an engineering bias, and at least two years' experience in an industrial research environment.

The salary will be in the range of £4,500 to £5,000 and the work will be situated in modern laboratories in pleasant rural surroundings in Worcestershire.

Please write or telephone for an application form to:—

The Personnel Manager
Micropore International Limited
Hadzor Hall
Hadzor
DROITWICH
Worcs.
WR9 7DJ
Tel: 09057-4211

UNITED KINGDOM ATOMIC ENERGY AUTHORITY

Energy Storage

Harwell seeks a graduate physical scientist or engineer to join a small group now being set up to make an assessment of the national importance of different energy storage technologies and to define national research and development requirements. The group will first concentrate on energy storage at the domestic and industrial rather than the national system level. Applicants should have some post graduate experience and should be able to take a systems approach to their work.

The successful candidate will initially be based in Harwell's Materials Development Division and there will be opportunities for career development in a number of disciplinary areas.

The appointment, depending on age and qualifications, will be made at Higher or Senior Scientific Officer level and the starting salary will be in the range £4,388-£7,380.

For further details and application form write to, Mr. R.J. Brockett, Appointments Section 'A', Personnel Department, Building 329, A.E.R.E., Harwell, Didcot, Oxon. OX11 0RA, quoting Ref: MDDI.

HARWELL

UNIVERSITY OF OXFORD
Dyson Perrins (Organic Chemistry) Laboratory

Departmental Assistant

Applications are invited from organic chemists of postdoctoral status for the post of Department Assistant from 1 September, 1979. The salary will be on the scale £3883—£4882 pa according to age and experience and with membership of USS. The appointment will be for a period not exceeding 2 years and the successful applicant will be expected to collaborate with one of the research groups and supervise undergraduate experiments.

Further particulars may be obtained from the Administrator, Dyson Perrins Laboratory, South Parks Road, Oxford OX1 3QY to whom applications with the names of two referees should be sent by 28 February.

UCG Coláiste na hOllscoile Gaillimh

SENIOR TECHNICIAN

Department of Chemistry

Applications are invited from qualified persons experienced in the servicing and maintenance of a wide range of analytical instruments.

Qualifications: (1) NCEA Certificate in Instrumentation, Electronics or equivalent qualification.

(2) Practical experience in Instrumentation and workshop practice.

Salary: £4301 × 5—£4873 (+2% after 1 March 1979)

Written applications, together with the names of two referees, should be lodged with the Professor of Chemistry, University College, Galway before 19 February 1979.

THE SCOTTISH FARM BUILDINGS
INVESTIGATION UNIT
AT
THE NORTH OF SCOTLAND
COLLEGE OF AGRICULTURE

RESEARCH ENGINEER/PHYSICIST

Applications are invited from first or upper second class honours graduates within the physical sciences for the post of physical scientist for research in Farm Buildings. The successful candidate will prepare and carry out, within a multidisciplinary unit, research and development projects initially in the field of mechanical interactions between animals and the built environment, in the context of intensive livestock production and farm buildings.

Salary Scale according to qualifications and experience:—

Grade III £4178—£6898

Grade IV £2998—£3924

Superannuation Scheme.

Application forms and further particulars (Reference Number 05/79) may be obtained from the Secretary, The North of Scotland College of Agriculture, School of Agriculture Building, 581 King Street, Aberdeen AB9 1UD with whom applications should be lodged not later than 28 February, 1979.

UNIVERSITY OF SOUTHAMPTON
Department of Biology

Applications are invited for the post of

LECTURER

in the Department of Biology. Candidates should have a special interest in Plant Ecology and should expect to contribute fully to the general teaching in the Department.

Salary scale £3883-£7754 per annum+USS. Initial salary will depend on qualifications and experience.

Further particulars may be obtained from Mrs E. C. P. Sears, Staffing Section, The University, Highfield, Southampton SO9 5NH, to whom applications (7 copies), naming three referees should be sent, as soon as possible and not later than 9 March, 1979. Please quote reference number 1609/R/NSc.

TECHNICIAN

required to become part of research team investigating the central nervous control of the Cardiovascular system using neuroanatomical, neurophysiological and circulatory techniques. Knowledge of neurohistology preferred.
Salary scale £2688—£3060 pa
Ref: 429/C/22.

Application form from:
Assistant Secretary, Personnel Office, University of Birmingham, P.O. Box 363, Birmingham B15 2TT.

UNIVERSITY OF MANCHESTER
Department of Physics

LASER RESEARCH

Applications are invited for a post of Research Associate in the Department of Physics for work on one of the following topics: laser coherent interactions with matter, new gas lasers or laser techniques. Previous research or development experience in related fields is desirable. The post is for two years in the first instance. Initial salary within the range £4382-£5604 pa. Superannuation. Applications with curriculum vitae and the names of two referees should be sent to Dr T. A. King, Department of Physics, Schuster Laboratory, The University, Manchester M13 9PL.

High-Level Technical Liaison with Engine Manufacturers

Salary into five figures

Our client, Esso Chemical Limited, is an acknowledged world leader in the petroleum additives field. The company produces a range of products used in the lubrication of automotive as well as machine and heavy-duty diesel equipment. Additives are also produced for automatic transmission fluids, gear and industrial oils.

An engineer is required to monitor and assess developments in engine technology which will affect long-term lubricant requirements, and advise the internal marketing and technology groups accordingly. This will involve considerable interaction with the European as well as the UK automotive industry. The Market Technical Developments Engineer will also communicate to the market-place new developments in technology and discuss with engine manufacturers high-level technical issues and recommend solutions.

This job calls for someone of outstanding ability. Technically he/she must be able to discuss highly complex technical problems with senior executives and quickly establish his/her credentials as an expert of some real repute. We would therefore like to discuss this key appointment with candidates with an outstanding record of achievement in a related field. A thorough understanding of the state-of-the-art in lubrication technology is of critical importance. We will wish to see evidence of high intellectual attributes and, as this is very much a communicating role, skill with people.

Candidates are invited to apply by either sending a curriculum vitae or telephoning for an Application Form. Please quote reference MTD. At this stage all approaches will be treated in the strictest confidence.

Cambridge Recruitment Consultants

1a Rose Crescent, Cambridge CB2 3LL. Telephone: 0223 311316

INORGANIC ANALYST

For New Product Research

As the Research Division of the Wilkinson Match Group, we play a key role in creating new products for international markets. Our research embraces many fields of science and engineering and is directed towards such well-known products as Wilkinson Sword razors and tools, Swan Vestas and Brymay matches, Graviner fire protection systems and Pains-Wessex pyrotechnics.

Our Central Scientific Group is looking for an INORGANIC ANALYST. The main task will be to solve analytical problems arising in multidisciplinary research and in the manufacture of our diverse product range. The work will be far from routine, involving the development of analytical techniques as well as the application of standard methods.

This is a job for an independent thinker, knowledgeable in techniques of wet chemical analysis and skilled in the application of modern analytical instrumentation. We think it needs a good first degree in Chemistry followed by at least a year's experience of analysis in a research environment, or a degree in Analytical Chemistry.

If you measure up to our requirements, we will offer a good starting salary and first-class terms of employment. You will join a team of research scientists and engineers working on projects in well-equipped laboratories.

Please write with details of your qualifications, career to date and current salary to: **Personnel Officer, Wilkinson Match Ltd., Research Division, Poyle Road, Colnbrook, Slough SL3 0HA.**

Wilkinson Match

TECHNOLOGIST

A vacancy has arisen in the Laboratory of a Company specialising in the development and manufacture of plastics powders, which are used for coating a wide variety of articles and components.

Candidates for this position will find that formal qualifications, preferably in a materials science, will be an advantage. However, the prime requirements are for the applicants to be self motivated and after a suitable induction period to be able to work on technical problems with the minimum of supervision.

Applications are invited from individuals who wish to become involved in a new fast growing technology. Facilities for further education on a day release basis are available up to graduate level.

Company benefits include:

- ★ subsidised canteen
- ★ sports and social club
- ★ sick pay scheme
- ★ contributory pension scheme with free life assurance
- ★ 4 weeks' holiday after one year's service.

Please apply giving full details of qualifications etc. to:

Mrs L. Cumper,
MACPHERSON POWDERS LIMITED,
Jenkins Lane,
Barking,
Essex.

Copyrighted material

Physicists: Would you know a good idea if you saw one?

Isaac Newton really knew what to make of a good idea when it struck him.
If you do too, then we'd like to hear from you.
Because we're after some dedicated brains to put great ideas into action at our new advanced engineering unit near Bournemouth.
We're moving into some completely new technological areas.
So we're prepared to pay well and offer generous help with relocation just to make sure we get the right people.
People who'll welcome the challenge of the diverse, sophisticated problems they'll come up against working on our advanced development and design projects.

As a physicist you'll be a key member of a small team working on a long term project dealing with low frequency electro-magnetic fields.
The team will investigate the properties of ELF propagation, assessing problems as they arise and developing theoretical models.
You'll be expected to make predictions from these models and then to test them by trials and measurements in the field.
Ideally you should be under 35, strongly self motivated, with a good degree in Physics, or perhaps even a PhD: a young practical academic looking for a genuinely challenging application for your expertise.

If that sounds like you, why not contact Peter Redican on 0782 262255.
It could be the best idea you've had in ages.

Applications from both men and women are welcome

PER
Professional
& Executive
Recruitment

THORN
THORN AUTOMATION

INFORMATION PUBLISHING TRANSLATORS/ABSTRACTORS

Information Retrieval is an international publishing company whose publications include some twenty abstracts journals in the biological sciences.

We are seeking recent graduates in microbiology, biochemistry or general biology to join our Editorial Department as full-time Translators/Abstractors. Applicants should have a good working knowledge of French or German and duties will include cataloguing and preparing abstracts of French and German scientific literature. Starting salary £3769 pa.

Please apply in writing, enclosing a full curriculum vitae to:

IRL®

Eleine Coeat
Managing Editor
Information
Retrieval Ltd.
1 Felconberg
Court
London W1V 5FG.

Abstracting at home

Engineers and Chemists are required to prepare abstracts in English of patent specifications.

No previous experience is required. A good reading knowledge of Swedish, Japanese, Russian, Danish or Romanian is essential.

Please apply to:

The General Manager,
DERWENT PUBLICATIONS LTD.,
Rochdale House,
128 Theobalds Road,
London WC1X 8RP.

1977
THE QUEEN'S AWARD FOR EXPORT ACHIEVEMENT

UNIVERSITY OF MALAWI
Bunda College of Agriculture

Applications are invited for the following posts in the

Department of Livestock Production

LECTURER IN LIVESTOCK NUTRITION

Applicants should have a good degree in Agriculture, or Animal husbandry or a related discipline, with postgraduate qualification in Livestock Nutrition. Practical experience in livestock management would be an advantage. The appointee's major responsibility will be to teach applied livestock nutrition to Degree and Diploma students who will have taken courses in Agricultural Chemistry and Biochemistry. There are opportunities for research.

LECTURER IN ANIMAL HEALTH

Applicants should have a degree or other recognised University level qualifications in Veterinary Science (such as MRCVS), or alternatively a basic degree in Biology or Agricultural practical experience in the handling and treatment of livestock. Duties will include teaching courses in Animal Health, and Management, with reference to diseases and parasites of Africa, practical demonstration, and research directed toward the improvement of animal health and production under local conditions.

Salary scale: Lecturer K3500-6600 pa (£1 sterling=K1·62). The British Government may supplement salary in range £3450-£3732 pa (sterling) for married appointees and £2340-£2544 pa (sterling) for single appointees (reviewed annually and normally free of tax) and provide children holiday visit passages and education allowances. If no British Government supplement is available, the University may pay an addition of between K1320-K1656 pa (taxable in Malawi). Family passages; superannuation scheme; gratuity 15-25%; biennial overseas leave; housing and various allowances. Detailed applications (2 copies) with curriculum vitae and naming 3 referees to be sent to Registrar, University of Malawi, PO Box 278, Zomba, Malawi by 22 March, 1979. Applicants resident in the UK should also send one copy to Inter-University Council, 90-91 Tottenham Court Road, London W1P 0DT. Further details may be obtained from either address.

THE OPEN UNIVERSITY

FACUTTY OF SCIENCE

Lectureship in Biology

Applications are invited for a tenured lectureship in Vertebrate Physiology. The person appointed will be involved in the preparation and maintenance of the Biology Discipline's 2nd and 3rd level courses in Physiology, and will be expected to take an active interest in the development of the discipline's future offerings in the field of continuing education. He/she will be expected to undertake research either independently or in association with one of the existing research groups in the discipline. The successful candidate should have a good research record and teaching experience in a physiological area.

Commencing salary will be within the lecturer scale £3883-£7754 p.a. with USS benefits.

Application forms and further particulars are available from: The Recruitment Office (JD3661 3), The Open University, PO Box 75, Walton Hall, Milton Keynes, MK7 6AL, or telephone Milton Keynes 63404· there is a 24 hour answering service on 63868.

Closing date for applications: 1st March.

Senior Latex Technologist

Malaysia–£12,000 plus.

Our client is a major US corporation in a joint venture partnership with the Malaysian Government, manufacturing dipped goods, surgical gloves, etc.

The need is for a qualified Technologist whose experience covers dipped techniques and both natural rubber and synthetic compounding, production, and quality control. A professional qualification is essential and it is unlikely that candidates below the age of 30 will have the depth of experience our client seeks.

This is a permanent position, married or single status and benefits include house allowance and car allowance.

Please send career details in the first instance quoting reference 7210 to Richard Darvell,
Astral Recruitment Associates,
Astral House,
17-19 Maddox Street,
London W1R 0EY.
Telephone: 01-629 2356.

ARA *Astral Recruitment Associates*
Search. Selection. Recruitment Advertising

INDUSTRIAL HYGIENIST

Uxbridge

Up to £6000 + company car

Cape Industries Limited requires an Industrial Hygienist to join its small specialised Unit to carry out a wide range of environmental monitoring programmes.

The post offers an interesting career development to candidates seeking responsibility and the opportunity to work independently. The appointed candidate will be expected to visit a variety of industrial sites to carry out surveys on a full range of hygiene problems relating to airborne dusts, noise, chemicals, gases and fumes.

The laboratory is situated on the west side of London near Uxbridge and has an extensive range of technical facilities. Applicants must hold a scientific degree. Preference will be given to those who have attended a relevant course of training in industrial hygiene and now possess some practical experience, but this is not essential.

Salary up to £6000, with excellent benefits, including company car, pension and life assurance schemes etc.

Please reply to:—
Mr P. E. Waine
Cape Industries Ltd.
114 Park Street
London W1Y 4AB
Tel: 01-499-6022

CAPE

Systems Engineer

A young, dynamic, innovative systems engineer, male or female, is urgently required to join the R & D Group of Dames & Moore, an international firm of consultants in the environmental and applied earth sciences.

The Advanced Technology Group undertakes research and development in soil and rock mechanics, soil dynamics, earthquake engineering and structural engineering.

The successful candidate will immediately become involved in a number of current projects in the firm's London office. In addition there will be participation with firmwide projects requiring some travel to Europe and the U.S.A. Candidates should preferably have attained experience with a PDP 11-45 computer and have worked in a team involving stress analysis or scientific computing. Candidates must be able to work without direct technical supervision in a challenging multi-discipline environment.

Salary will be negotiable to an international level reflecting the self reliance this position demands. An attractive benefits package includes top-up pension scheme, free life and accident insurance, travel benefit programme, and flexible working hours. The firm's offices are located in pleasant surroundings by the Thames in Mortlake.

Please write in strict confidence enclosing complete resume to: Richard Owen, Dames & Moore, The Limes, 123 Mortlake High Street, London SW14.

DAMES & MOORE

University of Sussex

School of Biological Sciences

Research Technician

(Grade 3)

Required to work with a member of the Biochemistry Group on a research project concerned with the mechanism of action of a membrane-bound enzyme. Experience in the application of the common biochemical techniques, including centrifugation and radioactive tracers is highly desirable. (Applicants must possess an ONC or equivalent qualification and have had at least three years relevant laboratory experience.)

The post is supported by the SRC for the period 1 April, 1979 until the end of March, 1981.

Salary within the range £2688—£3060 p.a. (under review), depending on age and experience.

Twenty days annual leave, plus University closures at Christmas and Easter and Public holidays. Hours: 9.00 am—5.30 pm, 5-day week.

Applications in writing to: Laboratory Superintendent, School of Biological Sciences, University of Sussex, Falmer, Brighton BN1 9QG.

Senior Optical Engineer

OTF and Image Photometry

We require a Senior Optical Engineer to join one of our teams working on sophisticated systems development. Our development team concept is highly successful and offers considerable interest and challenge in a highly technical environment.

The job involves the design and specification of components and optical systems.

Candidates of either sex should hold a B.Sc. Honours or Masters Degree and have extensive experience of OTF and statistical tolerance methods for the alignment of multi-component optical systems plus a good understanding of image photometry. Both guidance and an opportunity to gain excellent experience on advanced optical systems will be given by staff supervising the project.

The salary and benefits package is excellent and full relocation assistance is also available to this pleasant part of Hertfordshire.

To find out more phone Jim Collingham on Welwyn Garden City 35794 or write to him at Rank Xerox Engineering Group, Bessemer Road, Welwyn Garden City, Herts. AL7 1HE.

In the evenings and at weekends an answering service is available on Milton Keynes 312870.

RANK XEROX
ENGINEERING GROUP

Research Analyst

Mars are a leading manufacturer of confectionery in a highly competitive and rapidly changing market, and to maintain our position constant research is necessary in all areas from raw materials to the finished products, as well as their packaging. To aid us in this research we require an additional Research Analyst.

Creativity and ingenuity are called for in this post which involves all aspects of analysis of raw materials, intermediates and finished products including investigation of new analytical methods. The successful applicant will possess an HNC in Chemistry plus two years analytical experience involving classical and instrumental techniques, preferably including HPLC. In addition he or she should welcome the challenge of working in an environment where the constraints are few.

The job is located in a modern, well equipped laboratory which is responsible for keeping the company abreast of current developments in analysis.

In addition to the excellent career opportunities we are offering an above average salary and a generous range of non-contributory benefits.

For an application form phone or write to Lesley Futerman, Personnel Officer, Mars Limited, Dundee Road, Slough, Berkshire.
Telephone: Slough 23932 ext 448.

Mars

CENTRAL PUBLIC HEALTH LABORATORY

National Collection of Type Cultures (NCTC)

SYSTEMS DESIGNER/ PROGRAMMER

A systems designer/programmer, preferably a science graduate, is required for the operation of a bacterial identification service. Bacteria from clinical sources are identified by probablistic analysis of test results by reference to computer-stored data bases. Systems use Optical Mark Reader forms, Data Recognition (Dataterm 3) Machine, Extel punch tape terminal connected to the LUCS 6500 time sharing system: current software in FORTRAN IV. There is considerable scope for improving the responsiveness of the system and the efficient storage and retrieval of data, and to revise the methodology or explore alternative methods. Sympathetic consideration would be given for specialised training, if required.

Grading dependent upon basic qualifications in appropriate subjects and on experience.

Salary scales: Scientific Probationary scale £2991-£4275 plus London Weighting (£354). Post Probationary scale £3798-£4899 plus London Weighting or Senior Scientific scale, if applicable, £5451-£6837 plus London Weighting. NHS Designated scale 9: £4959-£6025 plus London Weighting.

Ring 01-205 7041 for a more detailed job description (Dr L. R. Hill, on Extn 47) and for an application form (Personnel Officer, on Extn 12)—Central Public Health Laboratory, Colindale Avenue, Colindale, London NW9. Closing date: 22 February, 1979.

UNIVERSITY OF NOTTINGHAM
MEDICAL SCHOOL

RESEARCH WORKER

Applications are invited for the above post within the Department of Psychiatry to work part-time on a three-year study into the long-term psychological effects of hospitalisation on children. The successful applicant will be required to assist in the collection and analysis of data, the major responsibility being the interviewing of parents in their own homes. Preference will be given to candidates with an honours degree in psychology or a professional qualification in a related subject and experience in interviewing would be an advantage. Applicants should also possess their own car. Mileage allowance is payable.

Salary will be the half-time equivalent of the Range 1B scale for Research and Analogous staff (£3384 X £250 (6) to £4882). Salary will depend on qualifications and experience.

Applications with names of three referees to: Dr P. J. Standen, Behavioural Sciences Section, Medical School, Queen's Medical Centre, Nottingham NG7 2UH, by 16 February, 1979.

UNIVERSITY OF DURHAM

Department of Zoology

Applications are invited for the post of

LECTURER IN ANIMAL BEHAVIOUR

tenable from 1 October, 1979. Candidates should have field experience and be able to assist with ecological teaching and with the development of Joint Honours courses with Psychology and Anthropology.

Salary on the scale £3883-£7754 per annum (under review) plus USS.

Applications (3 copies) naming three referees, should be sent by 23 February, 1979, to the Registrar and Secretary, Science Laboratories, South Road, Durham DH1 3LE, from whom further particulars may be obtained.

If you are a graduate, age 26 or over, with a first or second class honours degree plus at least four years' relevant postgraduate experience and would like to make a career in research administration, a post of

Scientific Administrative Officer

in the Medical Research Coucil headquarters office in London, should be of interest to you. Research experience in fields associated with medicine in the broadest sense and a research degree would be an advantage. Initially the successful candidate is likely to work in the Grants and Training Awards Section which is responsible for handling all aspects of the project grants, fellowships and studentships awarded by the Council.

The MRC is the main UK Government agency for the promotion of medical research and its headquarters office is resoonsible for the administration of an extensive programme of research which is carried out by directly supported staff in the Council's own establishments as well as by other research workers funded by MRC grants and other awards. Salary will be in the range £5619 to £7363 per annum. In addition there is a pay supplement to compensate for contributions to the Council's pension scheme. Subject to satisfactory completion of a two years' probationary period, the appointment will be established, there is opportunity for promotion.

Application forms may be obtained by writing to or telephoning Miss M. Gale, Medical Research Council, 20 Park Crescent, London WIN 4AL (Tel. No. 636 5422 Ext. 35). Closing date for applications 26 February, 1979. Please quote P. 1002/39.

MRC
Medical Research Council

THE CHEMICAL SOCIETY EDUCATION OFFICER

Piccadilly W.I.

Applications are invited for the above post. Candidates should have a degree or equivalent in chemistry, and be in the age range 28-35. Knowledge of the educational system of the U.K. at all levels very desirable.

The person appointed will act as Secretary and Executive Officer to several committees concerned with educational meetings, symposia, refresher courses and other educational matters. He or she will be required to maintain close liaison with educational and other organisations both national and international. The post offers wide scope for initiative. The initial salary will be in the range of £5586 p.a.—£6500 p.a. plus London weighting allowance of £550 p.a. Pension Scheme, BUPA, 30 days holiday plus statutory holidays and usual benefits.

Application form and further particulars can be obtained from **The Personnel Officer, The Chemical Society, 30 Russell Square, London WCIB 5DT. Telephone 01-580 3482**

OVERSEAS TEACHING POSTS

DIRECTOR OF SCIENCE AND TECHNICIAN TRAINING (*EGYPT*)

SENIOR BIOLOGY TEACHER

SENIOR TEACHER, SCIENCE AND TECHNICIAN TRAINING

British Council Teaching Centre, Cairo.

Director required to prepare and teach GCE Chemistry and Physics courses plus administrative duties. Candidates should have chemistry degree plus 5-10 years teaching experience. Interest in or experience of teaching chemistry laboratory technicians desirable.

Salary: £6453-£7974 pa. 78 MO 218

Senior Biology Teacher required to prepare and teach Chemistry and Biology to GCE level and Chemistry and Biology to technicians. Candidates should have biology or biochemistry degree plus teaching certificate or 5 years experience.

Salary: £4503-£6960 pa. 78 MO 219

Senior Teacher, Science and Technician Training required to organise laboratories and teach laboratory procedures. Candidates should have biology or chemistry degree or good technician qualification. Practical experience as laboratory technician plus 2 years experience of teaching technicians or 5 years experience as a technician teacher.

Salary: £4503-£6960 pa. 78 MO 220

Benefits: (all 3 posts). Accommodation and married allowances. Air fares for wife and 2 children. 2 year sub-formula contract, renewable.

Return fares are paid. Local contracts are guaranteed by the British Council. Please write briefly stating qualifications and length of appropriate experience, quoting relevant reference number and title of post, for further details and application form to the British Council (Appointments) 65 Davies Street, London WIY 2AA.

THE BRITISH COUNCIL

M.R.C CLINICAL RESEARCH CENTRE
(Northwick Park Hospital)
Watford Road, Harrow, Middx. HAI 3UJ

Technician

required to join a group working in ambulatory blood pressure monitoring. Experience in computing and simple electronic technology desirable but not essential. Candidates must hold HNC or scientific degree. Salary within the range £3261 to £4680 a year plus £354 LW.

Application forms and further details obtainable from Mrs J. Tucker-Bull. 01-864 5311 ext 2685.

Please quote ref 111/2/4049/74. Closing date 28 February, 1979.

UNITED KINGDOM ATOMIC ENERGY AUTHORITY

Energy..Energy.. Energy...

The potential of both conventional and unconventional energy technologies in helping meet future energy needs is a topical and important subject.

If the full potential of these technologies is to be realised, research, development and demonstration programmes all have a vital part to play.

The Energy Technology Support Units of the U.K.A.E.A., located at Harwell, is responsible on behalf of the Department of Energy for initiating and managing many of these programmes, all of which are now expanding.

SCIENCE OR ENGINEERING GRADUATES in their late twenties or early thirties, are needed in the following areas:-

–Planning thenational programmes.

–Promotion and development of new and existing technologies in all areas of energy use to establish greater efficiency.

–Continuing development of solar, wind, wave, geothermal and tidal programmes.

Especially welcome are applications from those with industrial experience or those able to discuss technological matters effectively with senior people in both industry and Government.

Salary range: £5,514-£7,380

Write or 'phone: Steve Beackon, Personnel Department, UKAEA, Harwell, OXON, OX11 0RA. Abingdon (0235) 24141. Ext. 2058.

HARWELL

UNIVERSITY OF DUBLIN
Trinity College

Lecturer in Pure Mathematics

Applications are invited for the above post in the School of Mathematics, Trinity College, Dublin, which will become vacant on 1 October, 1979.

Salary Scale: £4232 — £4680.

Appointment is likely to be made within the range £4232 — £4680.

Application forms and further particulars relating to this post may be obtained from:

The Establishment Officer,
West Theatre,
Trinity College,
Dublin 2.

The closing date for receipt of applications will be 1 March, 1979.

Royal National Institute for the Blind

Assistant Technical Officer

Design Engineer, male or female, age 30-45, having Degree, Diploma or equivalent, for work on design of devices to aid blind people and development of processes and machines for producing braille. Some years practical and drawing office experience in field of light mechanical and electro-mechanical design, prototype development and follow-through to manufacture required. Knowledge of machine control techniques advantageous. Ability to produce accurate verbal and written reports essential. Salary £5208–£5508 p.a. (including London Weighting). Free lunch in staff restaurant. Excellent pension scheme.

Applications in writing to: Personnel Officer, 224 Great Portland St., London W1N 6AA.

POLYTECHNIC OF THE SOUTH BANK

Department of Physical Sciences & Technology

RESEARCH ASSISTANT

Required to work with Dr D. Randall and Mr G. Beattie on the optical, photoelectric and allied properties of thin films in vacuo.

Salary scale, including Inner London Allowance, £3087-£3261.

Apply by letter to **Dr D. Randall, Dept. of Physical Sciences & Technology, Polytechnic of the South Bank, Borough Road, London SE1 0AA.**

PIRA: THE RESEARCH ASSOCIATION FOR THE PAPER AND BOARD, PRINTING AND PACKAGING INDUSTRIES

PIRA is the UK Technical Centre for Paper and Board, Printing and Packaging, with a staff of approximately 170, situated in Leatherhead, Surrey. We have the following vacancies.

(1) QUALIFIED SCIENTIST OR ENGINEER (Ref. PB/SE/179)

The Paper & Board Division, which carries out research and development and also undertakes consultencies in the UK and overseas, is seeking a suitably qualified scientist or engineer to continue and extend its work on the recovery and recycling of wastepaper. Wastepaper is a vital resource, affecting both the UK economy and world ecology. This is reflected by the support given to this work by the UK Paper and Board Industry, the UK Government and the EEC.

Ideal applicants will have a Degree with, if possible, paper mill experience. They must be self-motivated and capable of working with minimum supervision. Experimental aptitudes and skills are essential. The preferred age range is 20-30 years.

(2) CHEMIST OR CHEMICAL ENGINEER (Ref. PB/CH/179)

The Paper & Board Division is also seeking a Chemist or Chemical Engineer for its Environmental Research Group. Experience in the Paper Industry would be useful but is not essential. However, applicants must have some practical experience of waste water treatment/pollution control and/or the construction/operation of pilot scale treatment plant.

This responsible position should appeal to young graduates aged between 23 and 27, who are self-motivated, commmercially orientated, capable of working with minimum supervision and seeking a job with a varied work programme.

(3) ANALYTICAL CHEMIST (Ref. PK/AA/179)

Our Packaging Division requires in its Analytical Group a young Chemist (aged about 25) to join them for research related to the compatibility of food with its packaging and to undertake analytical work relavant to the problems of the industries served by the Association.

Possession of HNC or LRIC is desirable and analytical experience is essential.

For application form please contact the Personnel Officer, PIRA, Randalle Road, Leatherhead, Surrey KT22 7RU, tel. Leatherhead 76161, quoting appropriate reference.

UNIVERSITY OF BRISTOL

DEPARTMENT OF ARCHITECTURE

The Department of Architecture has a lively research and postgraduate group working in the field of acoustics and thermal energy in buildings. A vacancy has arisen for a

TECHNICIAN

to provide electronic and laboratory assistance to the group. The work may involve the construction of prototype electronic devices, assistance with field studies, servicing and maintenance of laboratory apparatus and the application of micro-processors.

The post is at Grade 3 level (salary £2688-£3060 per annum, scale under review) and candidates should hold at least Ordinary National or City & Guilds (Pt 2) Certificate and have 3 to 5 years experience.

Further details and an application form may be obtained from: Mr Brien Day, Department of Architecture, 25 Great George Street, Bristol BS1 5RA.

Director of Technical Services-Europe

Insecticides c.£12,000+car

Our client, a significant subsidiary of a major multinational corporation, manufactures and markets insecticide and animal health products.

The company is expanding rapidly in Europe, especially in France, Germany and Benelux, and now seeks a well-qualified scientist to control all regulatory and technical affairs in Europe, with some involvement in Africa and the Middle East.

The person sought will be 30-45, a graduate in Chemistry or a life science, with some experience with appropriate regulatory authorities in Continental Europe. A capability in French or another European language would be useful.

Salary is negotiable and could well go above the indicator figure. This is an interesting opportunity to become a key member of a compact, dynamic management team in a rapidly expanding operation with exciting potential.

For further information telephone or write with brief career details, quoting ref. 842, to John F. Fulford, **Grosvenor Stewart Limited,** Hamilton House, 15 Tilehouse Street, Hitchin, Herts. Tel. (0462) 55303.

GS

GROSVENOR STEWART
Executive Search and Selection

RESEARCH SCIENTIST

THE PHARMACOLOGY OF FEVER

The National Institute of Biological Standards and Control is a recently established multi-disciplinary Institute concerned with the standardization and control of biological substances important in medicine.

The Institute's Division of Hormones requires a research scientist for a three year appointment for work involving the mechanism of fever production, the action of bacterial pyrogens and the development of methods for the measurement of their effects. The work will provide good opportunities for collaboration both in the UK and internationally.

Candidates should preferably possess a PhD although those with a good honours degree in pharmacology or a related subject will be considered. It is hoped that the person appointed will be able to take up the post as soon as possible.

Salary will be in accordance with the scales for university non-clinical lecturing staff and will initially be in the range **£4303 to £6500 p.a.**

Please write or telephone, for an application form quoting Ref No: 0138, to the Personnel Officer, National Institute for Biological Standards and Control, Holly Hill, Hampstead, London NW3 6RB,
Tel: 01-435 2232, ext 211.
Closing date: 23.2.79

NIBSC

National Institute for Biological Standards and Control

DRUG METABOLISM

A new appointment within our drug metabolism unit provides a first class opportunity for a career orientated individual to assume wide responsibilities for the efficient performance of metabolic projects, including proposal activity, client liaison and project management.

The man or woman we seek will be under 30, possess a Phd and have a minimum of 2-3 years' experience of running studies in drug metabolism pharmacokinetics in a commercial environment. In addition he/she will possess the necessary skills to promote the company to clients and to effectively manage and motivate junior staff.

This is a senior post, reporting directly to the head of the department and has come about by the planned growth of the department which undertakes metabolic investigation in both animals and plants. Studies are conducted on behalf of the pharmaceutical, agrochemical and general chemical industries.

For an application form and further details of the position, the company, and Harrogate, please telephone:

BARBARA GRANT,
HAZLETON LABORATORIES EUROPE LTD.,
OTLEY ROAD,
HARROGATE.
TELEPHONE 0423 67265

HAZLETON
LABORATORIES EUROPE LTD

Quality Control Chemist Sudbury, Suffolk

We are the European Medical Division of Corning Glass Works – a large US multinational corporation. We develop, manufacture and market in-vitro clinical instruments.

We now wish to appoint a Quality Control Chemist to ensure that our precise levels of quality and reliability are maintained for reagents, ion selective electrodes and similar products. More specifically you will be responsible for defining quality control standards, preparing and implementing procedures to monitor both in-house and field failure rates. In addition you will investigate these failures and revise where necessary the appropriate quality control procedures or standards to ensure their cessation.

The successful candidate will be educated to at least HNC level in Chemistry. This is an ideal opportunity for an energetic man or woman with practical laboratory experience to further their career within this worldwide organisation.

We offer an attractive salary and the normal benefits associated with a large company. Assistance with relocation expenses will be given where appropriate.

For further details contact
Kathy Carpenter, Corning Medical, Corning Limited,
Northern Road, Chilton Industrial Estate, Sudbury,
Suffolk, CO10 6XD. Tel: Sudbury (07873) 76481.

CORNING

1975

Food Scientist

Tate & Lyle are now seeking an experienced Food Scientist to join their Group Research and Development Department in Reading.

You will work as an integral member of a team engaged on several research projects, including applications of sweetners, food additives and product development in general.

A relevant degree and 4-5 years post qualification experience in the food industry, preferably in R & D, are essential.

Salary will be commensurate with qualifications and experience and excellent fringe benefits include a non-contributory pension scheme and free meals.

Please apply in writing with full c.v. to the Director R & D Administration (FS), Tate & Lyle Limited, Group Research & Development, P.O. Box 68, Reading, Berks RG6 2BX.

Tate & Lyle

PAPUA NEW GUINEA UNIVERSITY OF TECHNOLOGY

Department of Applied Physics

RESEARCH ASSISTANT

The Department of Applied Physics invites applications from suitable physics graduates with interests in biophysics or medical physics to carry out research into the physical properties of samples of blood with special reference to its rheological properties.

Previous experience in this field of research is preferable, but not essential. Possibility of registering for a higher degree is available. Other research interests of the Department are in the field of radiation and geophysics.

The research fellow will also be required to assist in tutorial classes for about eight hours a week.

Candidates should be single and be prepared to live in a University students' hostel. They should be willing to take up the position by the end of March 1979.

Salary between K7000 to K8000 per annum.

Applications should be addressed to: The Registrar, Papua New Guinea University of Technology, PO Box 793, Lae, Papua New Guinea, and should comprise a full curriculum vitae, age, marital status, dependants, qualifications, experience, and names and addresses of three referees from whom confidential enquiries can be made.

Applications will close on 28 February, 1979. An additional copy of application should be sent to Association of Commonwealth Universities (Appts.), 36 Gordon Square, London WC1H 0PF.

ROTHAMSTED EXPERIMENTAL STATION
HARPENDEN, HERTS. AL5 2JQ

PHYSICIST APPLIED PHYSICIST or ELECTRONICS ENGINEER

to support data acquisition phases of Physics Department field experiments into the effects of tillage and drought on crop growth.

Qualifications: Degree, HNC or equivalent in physics, applied physics or electronic engineering, with adequate mathematical training and experience of electronic circuitry and/or computer programming. Acceptable post-qualifying experience is required for appointment to the higher grade. Driving licence particularly useful. Appointment in grade of Scientific Officer (£2,839—£4,415 pa) or Higher Scientific Officer (£4,101—£5,448). Starting salary according to qualifications and experience. Non-contributory superannuation. Apply in writing to the Secretary, giving names and addresses of two referees and quoting Ref. 386 by 1st March, 1979. Further details on request.

INSTITUTE OF CANCER RESEARCH

TECHNICIAN GRADE A

required to assist in carcinogenesis studies with small animals at Pollards Wood Research Station, Chalfont St Giles, Bucks. The work includes routine maintenance of animals and assistance with various experimental procedures. Associateship of the Institute of Animal Technicians and current Home Office licence required. Starting salary not less than £3261 per annum. Applications in duplicate with the names of two referees to the Secretary, Institute of Cancer Research, 34 Sumner Place, London SW7 3NU, quoting ref. 301/B/58.

WELSH NATIONAL
SCHOOL OF MEDICINE
(University of Wales)
DEPARTMENT OF ANAESTHETICS

RESEARCH OFFICER

A Research Officer with an Honours degree in a science subject, preferably Physics or Electronic Engineering, is required to work on a variety of scientific projects in the above Department. The applicant should have some experience in either electronics, computer programming (preferably real-time) or statistics, although these need not have been the main subject of the degree. The applicant will work in close collaboration with Professor W. W. Mapleson, Professor of Physics of Anaesthesia.

Appointment in the first instance for three years. Salary on the scale £3324—£4882 (under review); starting point depending on qualifications and experience.

Applications in the form of a curriculum vitae with the names and addresses of two referees should be sent to the Registrar and Secretary, Welsh National School of Medicine, Heath Park, Cardiff CF4 4XN from whom further particulars (quoting ref. No. A9) may be obtained (0222/755944 ext. 2073).

THE KENNEDY INSTITUTE OF RHEUMATOLOGY

A JUNIOR TECHNICIAN

is required in the Division of Experimental Pathology to assist in a project connected with studying the effects of physical and chemical agents on organ cultures. The post, which is funded by a grant for two years, will provide an interesting range of experience involving tissue culture and immunology.

Preferred qualifications are 'A' levels in science subjects or an ONC. Whitley Council salary scales for junior technicians apply. The starting date for the appointment will be 1 February, 1979. Written applications giving full details and naming two referees to: The Laboratory Superintendent, The Mathilda and Terence Kennedy Institute of Rheumatology, Bute Gardens, Hammersmith W6 7DW.

UNIVERSITY OF ABERDEEN

Department of Zoology

RESEARCH ASSISTANT

Applications are invited for the above post, funded by World Health Organisation, to study amino acid transport and protein synthesis in a blood-dwelling parasite. Candidates should possess an honours degree in Biochemistry, Zoology or Parasitology.

The appointment will be for 30 months, to commence as soon as possible. Salary (within Range 1B) £3384-£3883 per annum with appropriate placing.

Further particulars from The Secretary, The University, Aberdeen, with whom applications (two copies) should be lodged by 23 February, 1979, quoting reference LC1.

IMPERIAL COLLEGE

RESEARCH ASSISTANT

Postdoctoral Agricultural Scientist required for key post in research team working on trace elements in soils in relation to agriculture. Applicant should hold good degree in agriculture or soil science and preferably have some experience of geology. Starting salary according to age and experience in the range £4359-£5847 (including London allowance) with USS.

Applications to Dr I. Thornton, Applied Geochemistry Group, Department of Geology, Imperial College, London SW7.

PATENTS ASSISTANT

An opportunity has arisen for a young Graduate to train for a career in patents work in the patents department of the Wiggins Teape Group Limited, which is located in pleasant surroundings at the Wiggins Teape Research Centre in Beaconsfield, Buckinghamshire. The Wiggins Teape Group manufactures and seals a wide range of speciality papers, and the workload of its patents department reflects this. The degree subject required is preferably chemistry, but study of chemistry as a subsidiary subject may suffice.

Patents work presents a considerable intellectual challenge and offers the chance of responsibility at an early age. The person appointed will initially assist the group's patent agents with the drafting of patent applications and their prosecution through to grant. With more experience, there will be the opportunity of involvement in patent infringement, opposition and advice work.

The person appointed will be encouraged to sit the professional examinations leading to qualifications as a chartered patent agent and European Patent Attorney, which require considerable spare time study;—the rewards for success are at least comparable with those of the other professions.

The work demands an analytical mind, an above-average command of English, the ability to assimilate a wide range of technologies and, with more experience, to work independently to tight deadlines.

If you are interested in this vacancy, please contact the Personnel Services Department at the address below for an application form.

WIGGINS TEAPE

RESEARCH & DEVELOPMENT LTD.

Butler's Court, Beaconsfield, Bucks. HP9 1RT.
Tel: Beaconsfield (STD 049 46) 5652.

WELLCOME MUSEUM OF THE HISTORY OF MEDICINE
SCIENCE MUSEUM LONDON SW7 2DD

APPOINTMENT OF CATALOGUERS

Applications are invited from men and women for 2 posts of Cataloguers concerned with the setting up of this Museum.

The posts are based at the Wellcome Store, Enfield, North East London, being for an initial period of one year. There is a possibility that the appointment may be extended to a total of not more than five years. They will be non Civil Service appointments.

Candidates should normally have a degree or equivalent qualification but candidates with other qualifications and who have had particularly suitable professional experience may also be considered. A sense of history with an interest in the purpose of the Museum will also be looked for. The prime duty is to see that the specially-designed catalogue cards are completed in a standard but informative manner using information derived from existing records and from inspection of objects themselves. Clear handwriting is essential.

The salary including Outer London Weighting will be within the scale £3114 to £4690. Point of entry will be determined by the age and experience of the candidate.

No pension scheme applies to these posts but service of more than two years will attract a Short Service payment on completion of the appointment.

Application forms and particulars form:—

The Establishment Office, Science Museum, Exhibition Road,
LONDON SW7 2DD or telephone 01 589 3456 Ext. 594

Completed application forms to be returned by 27 February, 1979.

HEAD OF DEPARTMENT PROCESS ASSESSMENT AND DEVELOPMENT

SATRA (The Shoe and Allied Trades Research Association) is the leading footwear industry research institute in the western world.

In 1979 it is embarking upon a substantial new development programme for the footwear industry. A vacancy has arisen for a person to lead a team of scientists and shoemakers in the assessment of existing manufacturing processes and the subsequent development of new processes and equipment.

A physics graduate is preferred and the successful applicant is likely to be in his/her early 30s.

Previous experience of the footwear industry is not essential but the ability to bring an enthusiastic scientific approach with clarity of thought, to the problems of a craft based industry is required. The planning of experiments and correct interpretation of results is an important aspect of the work.

An appreciation of electronics would be an advantage since it is expected that the new work programmes will include microprocessor based developments.

The Association's laboratories are situated on the outskirts of Kettering in Northamptonshire and assistance with relocation will be provided. Working conditions are good and the salary which will be negotiated is subject to annual reviews. A non-contributory pension scheme is in operation and other benefits include membership of BUPA.

Applications in writing to:—

R. G. Coulson, Manager, Process Research Division, Shoe & Allied Trades Research Association, SATRA House, Rockingham Road, Kettering, Northants NN16 9JH.

SUB-EDITOR

required for the publications Computer Communications and Information Privacy. Both are interdisciplinary and cover the technology of computers, telecommunications and information systems, and their effects on society. The issues they address are important and inverse. We are looking for a person with a good command of English, a concern for detail, an ability to work under pressure and a technical background. He or she must be able to get on well with people at all levels. Previous editorial experience would be an advantage but not essential. Salary up to £4331 per annum.

For further information please contact Ms G. Hawkes, IPC Science and Technology Press Limited, Westbury House, Bury Street, Guildford, Surrey GU2 5AW. Telephone: 0483 31261.

UNIVERSITY OF LONDON

Institute of Neurology

Gough Cooper Department of Neurological Surgery

TECHNICIAN GRADE 3 OR 4

required to work in the Department's Research Laboratories and in the National Hospital, Queen Square. Duties will develop under the supervision of research and clinical staff. Interest in, or knowledge of, physiology or electronics will be advantageous. Starting salary including London weighting in range £3153 to £3867.

Applications in writing, with the names of two referees, to the Secretary, Institute of Neurology, National Hospital, Queen Square, London WC1N 3BG.

THE UNIVERSITY OF HULL

Department of Plant Biology

GRADE 6 TECHNICIAN

Applications are invited for the post of Technician in charge of the teaching services in the Department of Plant Biology. Candidates should hold an HNC or equivalent qualification and have 9-10 years' experience. The post is tenable from mid-April. Salary on the scale £3654-£4365 (under review).

Applications, giving details of age, qualifications, experience and the names of two referees should reach the Personnel Officer, University of Hull, HU6 7RX, by 26 February, 1979. Further particulars are available.

ELECTRONIC ENGINEERS

SMITHS INDUSTRIES LIMITED AVIATION DIVISION have openings in their Research & Engineering Department which will appeal to Engineers who seek a challenging and rewarding vocation.
If you are interested in any of the following fields:–

- ★DIGITAL HARDWARE/ SOFTWARE (REAL-TIME COMPUTING)
- ★COMPONENT APPROVAL
- ★ANALOGUE HARDWARE
- ★CONTROL SYSTEMS (ANALYSTS & DESIGNERS– FIXED AND ROTARY WING AIRCRAFT)

we have vacancies at various levels in these Design Branches:–

- ●FLIGHT DECK INSTRUMENTS
- ●TEST EQUIPMENT
- ●ELECTRONIC DISPLAYS
- ●MICRO ELECTRONICS
- ●WEAPON SYSTEMS (AVIONIC & NAVAL)
- ●FLIGHT CONTROL SYSTEMS
- ●FLIGHT CONTROL RESEARCH
- ●ENGINEERING STANDARDS
- ●COMPONENTS ENGINEERING (GYROS & ACCELEROMETERS)

Applicants should have preferably a Degree with a minimum of two years experience although, relevant experience or other qualifications in lieu would be considered.

Write to
H. Upson,
SMITHS INDUSTRIES LIMITED
AVIATION DIVISION
Bishops Cleeve, Cheltenham, Glos. GL52 4SF.
or use our ANSAFONE facility:– (0242-67-5359)

Software and Systems Engineers

Will the U.K.'s top 50 please contact us?

We have been asked by one of the UK's leading electronics research organisations to identify some of the best Software and Systems Engineers in the country to work on a variety of state-of-the-art projects. The professional and technical challenge will be substantial.

We are looking for junior to principal engineers. Salaries range from £4000 to £8000 pa. Real-time programming or systems design expertise, ideally for microprocessor applications, is the key criterion.

To apply, either send a curriculum vitae or telephone for an application form, quoting ref. SE/10.

Cambridge Recruitment Consultants
1a Rose Crescent, Cambridge CB2 3LL Telephone: (0223) 311316

INSTITUTE FOR CONSUMER ERGONOMICS

SENIOR RESEARCH ENGINEER

Applications are invited for the post of Senior Research Engineer to join a multi-disciplinary team on a DHSS sponsored project evaluating equipment for disabled people. Applicants should have a degree in mechanical engineering or cognate subject, together with some knowledge of research techniques. Experience or qualifications in bio-engineering and/or ergonomics would be an advantage.

Appointment will be of 3 years' duration in the first instance on a salary within scale 1A rising to £6555 (under review), with possibility of promotion to scale 11 (maximum £7754, under review) in due course. Further particulars and application form from **Alan Baker, Institute for for Consumer Ergonomics, University of Technology, Loughborough, Leicestershire LE11 3TU.**

CLARENDON LABORATORY OXFORD

SYNCHROTRON RADIATION

Applications are invited for a Postdoctoral appointment to investigate the application of Synchrotron Radiation to X-ray crystallography. The work will involve the design and implementation of two energy-dispersive diffractometers, together with associated computer software, for the new storage ring source under construction at the Daresbury Laboratory. In addition, the appointee will be expected to join in research into other types of X-ray crystallographic experiments at Daresbury and possibly at synchrotron sources elsewhere. Applicants should have experience in X-ray diffraction, instrumentation and computing.

The salary scale (under review) will be £3883-£6555, superannuable under USS and the appointment will be for up to 2¾ years, depending on age and date of appointment.

Curriculum vitae should be sent to Dr A. M. Glazer, Clarendon Laboratory, Parks Road, Oxford OX1 3PU, UK, to whom references from two referees should be sent directly.

UNIVERSITY OF LIVERPOOL
Department of Inorganic, Physical and Industrial Chemistry

Theory of Vibrational Phenomena in Adsorbates

Applications are invited for an

SRC POSTDOCTORAL SENIOR RESEARCH ASSISTANTSHIP

at an initial salary of between £3883 and £4382 per annum, with superannuation benefits. The post is tenable for one year in the first instance, and may be renewed for a further year. The project is the theoretical study of vibrational phenomena in adsorbates including electron energy loss spectroscopy, with Professor T. B. Grimley. The successful applicant will join an active group involved in the theoretical study of molecular and electronic processes on solid surfaces.

Applications, stating age, academic qualifications and experience, together with the names of two referees should be received not later than 5 March, 1979, by The Registrar, The University, PO Box 147, Liverpool L69 3BX. Quote Ref: 479/NS.

UNIVERSITY OF NEWCASTLE UPON TYNE

Department of Geology

LECTURER (SEDIMENTOLOGY)

Applications are invited for a lectureship (sedimentology) tenable from 1 October, 1979. Applicants should have had research experience within the field of clastic sedimentology. Experience in economic applications of sedimentology, especially if this has been gained in industry, would be an advantage.

Salary will be at an appropriate point on the lecturer scale £3883-£7754 per annum according to age, qualifications and experience. Membership of the appropriate University superannuation scheme will be required.

Further particulars may be obtained from the Registrar, The University, Newcastle upon Tyne NE1 7RU, with whom applications (3 copies) together with the names and addresses of three persons to whom reference may be made should be lodged not later than 9 March, 1979. Please quote reference NSc.

MEDICAL RESEARCH COUNCIL TRAUMA UNIT

Stopford Building, University of Manchester Medical School and Hope Hospital, Salford Lancashire

TECHNICIAN/ JUNIOR TECHNICIAN

required to take part in physiological research. The work would be mainly clinical, concerned with physiological and metabolic observations at the Hope Hospital.

Applicants should hold HNC, AIMLS or an equivalent qualification for appointment at Technician level. Salary on a scale rising from £3261 to £4680 for Technicians and from £1905 to £3105 per annum for Junior Technicians.

Applications should be sent by 23 February to The Director, MRC Trauma Unit, Stopford Building, University of Manchester, Oxford Road, Manchester M13 9PT.

UNIVERSITY OF WARWICK

GRADUATE RESEARCH ASSOCIATE IN PHYSICS

Professor P. N. Butcher is seeking a well qualified graduate to work with him for three years on the theory of hopping conductivity in amorphous semiconductors. The post is supported by the Science Research Council and is tenable for three years starting in October, 1979. Initial salary £3384 pa on the Range 1B scale: £3384, £3634, £3883 x £249-£4631, £4882 pa (under review).

Applications are invited from students taking their final undergraduate examinations in June 1979. The successful applicant will be expected to register for a PhD. Application forms from the Academic Registrar, University of Warwick, Coventry CV4 7AL, quoting Ref. No 26/A/79; to be returned as soon as possible.

TECHNICIAN (GRADE 3)

required in the Department of Zoology, University of Reading, to assist individual members of academic staff with research and preparation of material for practical classes as well as general departmental duties. ONC or equivalent qualification preferred. Knowledge of physiological techniques an advantage. Salary in scale £2688-£3060 pa (under review). Applications giving details of qualifications and experience and naming two referees, quoting Ref. T.S. 01A, to Assistant Bursar (Personnel), University of Reading, Whiteknights, Reading, Berks RG6 2AH.

CENTRAL ELECTRICITY RESEARCH LABORATORIES

Kelvin Avenue, Leatherhead, Surrey, KT22 7SE

Assistant Technical Officers

for Materials Science research in support of the Power Generation Industry.

The successful candidates will provide assistance to Research Officers working in one or more of the following areas: Metallurgical Analysis (electron microscope and X-ray techniques): Creep and Fracture Mechanics: Liquid Sodium Technology. Concrete Technology: High Temperature Corrosion.

Ideally applicants should be qualified to HNC standard or equivalent, but not above in an appropriate scientific discipline. Direct experience of one of the above topics in a research or analytical environment is desirable, but not essential and a knowledge of modern computer techniques would be an added advantage.

These appointments will be made within a salary range £3570-£5375 plus a Self-Financing Productivity Payment between £8 and £13 per month.

The Laboratories are situated in a pleasant part of Surrey and offer attractive conditions of service, and facilities for the total of 800 Research and Support Staff engaged in a broad spectrum of research into the materials, technologies and plant performance problems of the Central Electricity Generating Board.

Application forms are obtainable from the Head of Personnel Development & Services, Central Electricity Research Laboratories, at the above address or telephone Leatherhead 74488 Ext 363, quoting reference number RL/7. Closing date is: **Friday 23 February 1979.**

Assistant Chemist

to join ESAB Ltd, a Swedish multi-national organisation, world market leaders in the welding and cutting industry.

The successful candidate will be responsible to the Chief Chemist in the Technology Department. Applicants should have a degree in chemistry but a qualification of HNC or its equivalent will be considered. Practical experience of emission spectography, atomic absorption spectroscopy and X-ray fluorescence spectroscopy would be an advantage.

Salary is negotiable according to age and experience. Excellent benefits include participation in an annual profit-related bonus scheme and 23 days holiday.

ESAB

For an application form and job description, please contact: The Personnel Manager, ESAB Ltd, Beechings Way, Gillingham, Kent ME8 6PU. Tel. Medway 34455.

CANCER RESEARCH

"What can I do to help?" Everyone has asked that question—the answer is that you CAN help to fight cancer. The Imperial Cancer Research Fund, the largest independent cancer research centre in Europe, relies solely on voluntary contributions. Please send your donation to:—

IMPERIAL CANCER RESEARCH FUND
Room 542W, P.O. Box 123, Lincoln's Inn Fields, LONDON WC2A 3PX

BUREAUTECH (SCIENTIFIC STAFF AGENCY)

Top jobs for ONC/HNC/HND/AIMLT BSc. (Chem; Phys; Biol; Med. Lab. subjects; Electronics and Metallurgy.)

Immediate vacancies for Paint, Ink and Surface Coating Technologists. We find you the job free of charge. **Tel: 01-959 3517.**

THE OPEN UNIVERSITY

FACULTY OF SCIENCE

Research Assistant in Physics

The post is available immediately, starting date negotiable. The successful candidate will be required to develop electronic circuitry including interfaces for various data acquisition systems used in experiments in the Physics Discipline, which include work on biomagnetism, solar flux, semiconductor physics and nanosecond spectroscopy.

Applicants should hold a good honours degree in Physics Electronics or Electrical Engineering and be competent in modern electronics.

This post is available for three years in the first instance, with the possibility of renewal for a further two years. Commencing salary will be within the Research Assistant 18 scale £3384-£4882 p.a. with USS benefits.

Application forms and further particulars are available from: The Recruitment Office (JD3773/1), The Open University, PO Box 75, Walton Hall, Milton Keynes, MK7 6AL, or telephone Milton Keynes 63404: there is a 24 hour answering service on 63868.

Closing date for applications: 1st March.

UNIVERSITY OF READING

Stirling Engine Project

GRADUATE ENGINEER

with several years' experience in industry required to assist in development of a research engine. This is a multi-University project in which the Engineering Department at Reading is taking a leading role. The project is sponsored by SRC and several large industrial firms are involved. Applicants should have an honours degree in mechanical engineering and/or be a chartered engineer. The appointment will be for a fixed period of up to 17 months depending upon the starting date. There might be an extension but this cannot be guaranteed. Salary range £3883-£6555 pa (under review). USS superannuation. Apply, quoting Ref MS 14A, with curriculum vitae and the names of two referees to Assistant Bursar (Personnel), University of Reading, Whiteknights, Reading RG6 2AH.

HABERDASHERS' ASKE'S SCHOOL FOR GIRLS ELSTREE

HEAD OF SCIENCE

(Burnham Scale 4) required for September 1979. Experienced graduate physicists or chemists are invited to apply. The school has a strong science tradition with large science sixth form, spacious modern laboratory block with ample prep. room facilities. Candidates would be required to teach throughout the main school to Advanced and Scholarship Level. The school is independent former Direct Grant with 900 pupils. Apply to the Head Mistress with curriculum vitae and names of two referees. Haberdashers' Aske's School for Girls, Aldenham Road, Elstree, Herts WD6 3BT.

QUEEN ELIZABETH COLLEGE

Kensington

(University of London)

Department of Mathematics

PART-TIME LECTURER

required in session 1979-80 only, to teach a course of operational research to third year mathematics students. 40 lectures plus some tutorials, marking and examining. Fee £800.

Apply to Professor W. B. Bonnor, Mathematics Department, Queen Elizabeth College, Campden Hill Road, London W8 7AH.

COMPUTER SHIFT LEADER

for International Research Projects

Hydraulics Research Station, Wallingford, Oxon

Calculating the interaction of natural water processes and anticipating and solving the hydraulics problems associated with civil engineering projects, is a complex affair, often involving skilled computation.

The HRS has for many years been a world authority in this field, and has an international market for its expertise. This post is an opportunity for an experienced computer shift leader to supervise an ICL 1904S with multi-access facilities, running under George 3, and take responsibility for scheduling the work and supervising Computer Operators. There will be opportunities for standard software work, including the maintenance of the operating system and the development of system programs and macros.

Candidates, aged at least 27, should preferably have a Degree/HND/HNC or equivalent in an appropriate science subject and must have at least one year's operating experience.

Appointment will be as Scientific Officer (£2840—£4410, plus shift allowances) with starting salary according to experience and qualifications. Good housing prospects for married people moving into the area.

For further details and an application form (to be returned by 23 February 1979) write to Civil Service Commission, Alencon Link, Basingstoke, Hants RG21 1JB, or telephone Basingstoke (0256) 68551 (answering service operates outside office hours).

Please quote ref: S/5051.

Science Group
CIVIL SERVICE

THE HATFIELD POLYTECHNIC
PO BOX 109, HATFIELD
HERTS AL10 9AB

SCHOOL OF NATURAL SCIENCES

RESEARCH ASSISTANTSHIPS

POST I. MAMMALIAN PHYSIOLOGY REF: 167

There is an immediate vacancy for a suitably qualified graduate to work for a higher degree on non-adrenergic and non-cholinergic transmission on the rat gastric corpus. The post is tenable for two years in the first instance with possibility of extension for a third year.

For further details apply to Dr K. Wilson, Biological Sciences, Telephone Hatfield 68100, extension 483.

POST 2. ASTRONOMY & EARTH SCIENCES GROUP REF: 167

Applications are invited from graduates with an honours degree in geology to work on a contract to investigate rock weathering sponsored by the Overseas Unit of the Transport and Road Research Laboratory. An interest in applied petrology would be an advantage.

The appointment will be for an initial period of two years with the possibility of an extension for a further year. The person appointed would be expected to register for a higher degree.

The successful candidate will be expected to take up the post on 1 April, 1979, or as soon as possible thereafter.

Informal enquiries to Dr D. Cewsey, Hatfield 68100, extension 283, or write or telephone the Staffing Officer, extension 309.

Salary scale for both posts (which are superannuable): £2613—£2700—£2787 per annum plus £159 local weighting.
Closing date: 26 February, 1979.

RESEARCH TECHNICIAN (GRADE 6)

required in Department of Engineering, University of Reading, to assist on the Stirling Engine multi-University project, in which the Department is taking a leading role in the development of a research engine, sponsored by the Science Research Council. Several large industrial firms are also involved. Applicants should be indentured craftsmen with several years experience, preferably including electric welding (especially argon/arc). 16 months appointment; extension may be considered if funds permit, but not guaranteed. Salary in scale £3654-£4365 pa (under review). Apply for further details, quoting Ref. T. 11A, from the Assistant Bursar (Personnel), University of Reading, Whiteknights, Reading RG6 2AH.

UNIVERSITY OF LEICESTER

RESEARCH TECHNICIAN

Applications are invited for a Research Technician (Grade 3) to assist in a project involving ultrastructural studies in the carotid body. The position is funded by the MRC and will be for a period of three years in the first instance. Experience in electron microscopy is essential. Salary: £2688 to £3060 (under review).

Applicants should send details of education and previous employment, together with the names and addresses of two referees to Dr D. J. Pallot, Department of Anatomy, Leicester University, University Road, Leicester LE1 7RH.

MRC CLINICAL RESEARCH CENTRE
(Northwick Park Hospital)
Watford Road, Harrow, Middx HA1 3UJ

Technician

required for the division of rheumatology (connective tissue diseases research group). The work of this new group includes studies on HLA and disease. The selected applicant will be required to carry out tissue typing and allied procedures. Previous experience in serology and lymphocyte culture an advantage, but not essential.

Applicants should hold an HNC or science degree. Salary within the range £3165 to £5034 p.a. incl. LW. Application forms from **Mrs J. Tucker-Bull**. Please quote ref. 131/2/4314. Closing date 22 February, 1979.

HOUNSLOW HEALTH DISTRICT

West Middlesex Hospital
Isleworth, Middlesex

BASIC GRADE BIOCHEMIST

required in clinical biochemistry laboratory. Previous experience not essential. Wide range of techniques, including automation and radioimmune assay, providing the experience and opportunities needed to take higher qualifications.

The Department may be visited by appointment. Tel: 01-560 2121 Ext 548. Whitley Council terms and conditions of service apply.

Application form from: Mrs Pittman, Personnel Department, Tel: 560 2121 Ext 669.

TECHNICIAN

is required to assist in all aspects of Psychopharmacology research. Experience in the handling of animals is essential. Previous experience in biochemical assays and surgical procedures is desirable. This is a 3 year appointment. Negotiable starting date, but no later than 1 May.

Appointment will be on Grade 4 scale (Job No 5/2)—£3420-£3597 pa including London Weighting (under review). 4 weeks holiday plus Christmas & Easter breaks.

Applications stating all relevant experience, qualifications and two referees to: Personnel Officer, The School of Pharmacy, 29-39 Brunswick Square, London WC1N 1AX, to arrive not later than 19 February, 1979.

IMPERIAL COLLEGE OF SCIENCE AND TECHNOLOGY

SENIOR LECTURESHIP IN COMPUTING

Applications are invited to an important senior post in the Department of Computing and Control. An active interest in a relevant line of research is considered important. The successful candidate will be expected to play a significant role in future developments of the department.

Salary on Senior Lecturer scale £7506 to £9263 plus London allowance and USS benefits.

Further details may be obtained from Professor J. H. Westcott, Head of Department of Computing and Control, Imperial College, London SW7 2BZ, to whom applications including c.v., list of publications and names of three referees should be made not later than 23 February, 1979.

UNIVERSITY OF LEICESTER

Department of Geology

LECTURESHIP IN PALAEONTOLOGY

Applications are invited for the post of Lecturer in Palaeontology in the Department of Geology.

Salary according to qualifications and experience on the scale £3883 to £7754 a year (under review) with superannuation benefits.

Further particulars from the Registrar to whom applications should be sent by 15 February, 1979.

MEDICAL RESEARCH COUNCIL

National Institute for Medical Research

IMMUNOLOGIST

A young postdoctoral immunologist is required by the Laboratory for Leprosy and Mycobacterial Research to investigate immunity of mycobacterial infections. It is proposed that the person appointed will study particularly the immunological control of the growth of mycobacteria in tissue culture and in animals. The appointment will be for up to three years and will be in the salary range £4408-£6080 per annum according to age and qualifications, plus £450 pa London Allowance. Superannuation provision.

Applications, giving details of qualifications, experience and the names of two professional referees, should be sent to the Director, National Institute for Medical Research, Mill Hill, London NW7 1AA, before 31 March, 1979.

UNIVERSITY OF LONDON INSTITUTE OF EDUCATION

Science Education

POSTGRADUATE RESEARCH

Applications are invited from suitably qualified recent graduates and experienced educators who wish to pursue postgraduate (MPhil and PhD) research degrees on problems bearing upon the role of science in secondary and higher education. There is provision for students wishing to work in the history, sociology and philosophy of science education.

Candidates should possess appropriate first degrees in the social and/or natural sciences, and must satisfy University and Institute admission requirements.

Registration may be full-time or part-time. Full-time degree candidates may be eligible for SSRC studentships.

Applications for 1979-80 may be submitted at any time, but preferably no later than 1 June, 1979. Further information may be obtained from the Deputy Academic Registrar (Higher Degrees), University of London Institute of Education, 20 Bedford Way, London WC1H 0AL.

THE UNIVERSITY OF LEEDS

DEPARTMENT OF BIOCHEMISTRY

Applications are invited for the post of LECTURER in the above Department. The person appointed will participate in teaching biochemistry to science and to medical students. The Department provides good facilities and opportunities for research. The appointment will date from 1 October, 1979.
Salary on the scale for lecturers: £3883–£7754 (under review) according to age, qualifications and experience.
Application forms and further particulars may be obtained from the Registrar, The University, Leeds LS2 9JT, quoting reference number 83/17/E
Closing date for applications 12 March, 1979.

ST MARY'S HOSPITAL MEDICAL SCHOOL

(University of London)
Paddington, London W2 1PG

MEDICAL LABORATORY SCIENTIFIC OFFICER (QUALIFIED)

required in Department of Paediatrics. Candidates should have experience in biochemical analytical techniques and small laboratory animal procedures. Salary scale within range £3615-£5134 pa inclusive. Apply, The Secretary at above address quoting Ref P/MLSO.

ASSISTANT SCIENTIFIC OFFICERS

Home Office Scientific Advisory Branch, Central London and Ashford, Kent

The Scientific Advisory Branch has 2 vacancies with good career opportunities for Assistant Scientific Officers; one at the Headquarters in Central London and the other at Ashford in Kent.

The group at the London Headquarters who have a vacancy for an Assistant Scientific Officer is involved in a number of projects using several computers. The Assistant Scientific Officer will initially assist in a variety of tasks from the collection of information to the production of reports but will be required to learn to write or modify computer programmes and to use a computer terminal. Previous experience of computers is not required but would, of course, be helpful.

The group at our outstation at Ashford undertakes tests of materials and equipment to determine its suitability for use by the Home Office. Many of these trials are undertaken outdoors. The Assistant Scientific Officer will be required to assist with these and will be responsible for recording trials photographically or using closed circuit television, for keeping meteorological records and a library of experimental results. The group is a small one and so versatility and an ability to work as part of a team will be at a premium. Applicants need not have previous photographic experience.

MINIMUM QUALIFICATIONS: Four passes in GCE 'O' level or equivalent, including English language and mathematics; or ONC or equivalent. Additional 'O' levels or 'A' levels in mathematical or scientific subjects would be an advantage.

Age at least 16 and normally under 26 on 31 December 1979.

Assistant scientific officers are encouraged to take advantage of facilities for further education, and to study for higher qualifications.

SALARY: £1775–£2731 according to age, rising by annual increments to £3303. A London Allowance of £465 per annum is payable for the Central London posting.

Four weeks annual leave.

Registered disabled Persons will be considered.

Apply in writing by 19 February 1979 to Miss S M Swinborne, Room 203, Whittington House, 19-30 Alfred Place, London WC1E 7EJ.

Home Office

CHELSEA COLLEGE

University of London

GRADE 2B TECHNICIAN

required to assist in research and teaching activities within the Biophysics Section of the Basic Medical Sciences Group. Experience of Biophysical/Bioengineering or Physiological techniques would be an advantage. Salary scale (under review) £2994-£3345, inclusive of London Allowances. Enquiries and application forms from the Secretary, Biophysics Laboratory, Chelsea College, 17A Onslow Gardens, London SW7 3AL. (01-589 4438.)

GRADUATE OR POSTDOCTORAL RESEARCH ASSISTANT

required for $1\frac{1}{4}$ years in the Department of Microbiology for an MRC research project on cytomegalovirus immunovirology. Laboratory experience in virology essential.

Applications, with full curriculum vitae and the names of two referees, to the Secretary, Guy's Hospital Medical School, London Bridge SE1 9RT, quoting Ref. MC2.

BEDFORD COLLEGE

(University of London)

SPECIALISED INSTRUMENT TECHNICIAN

required for work in Regent's Park on the development and construction of equipment needed for ultra low temperature research and for other duties in the Department of Physics. Applicants for this Grade 5 established post should have a high standard of workshop manipulative skills and a willingness to apply them in relation to the novel techniques required. Preference will be given to applicants with some post-training experience.

Salary range (under review) £3186 to £3720 per annum plus £465 per annum London Weighting. 25 days annual leave plus statutory holidays. Season ticket loan scheme.

Applications to the Senior Assistant Secretary (Personnel), Bedford College (University of London), Regent's Park, London NW1 4NS (Tel: 01-486 4400 Ext 312). Further particulars are available.

UNIVERSITY OF SURREY

Department of Electronic and Electrical Engineering

Ion Implantation into Semi-conductors

TECHNICIAN GRADE 5

£3186-£3720 (under review)

A Technician Grade 5 is required in the Department of Electronic and Electrical Engineering to assist on Ion Implantation Research Group working with semiconductor materials. Applicants with experience of handling these materials and/or Vacuum equipment would be preferred. HNC or an equivalent qualification in either Applied Physics, Chemistry, Metallurgy or Electronics is required.

Qualifications: HNC / HND / Advanced City and Guilds plus 8-9 years' experience.

Application forms for this post may be obtained from the Staff Officer, University of Surrey, Guildford, Surrey GU2 5XH, or telephone Guildford 71281 ext 452.

Closing date for applications: 16 February, 1979.

KING'S COLLEGE HOSPITAL

STUDENT PHYSIOLOGICAL MEASUREMENT TECHNICIAN (CARDIOLOGY)

Applications are invited from young people who wish to train in this interesting field at one of London's busiest teaching hospitals. Candidates must have at least 4 'O' levels including English, Mathematics and one Science subject, preferably Physics. The successful applicant will be required to undertake further study on a day-release basis for the ONC in Physiological Measurement.

Salary: £2256 (at age 16) rising to £2985 (at age 23 or over).

Application form and job description available from the Sector Administrator's Office, King's College Hospital, Denmark Hill, London SE5 9RS. Tel: 01-274 6222 ext. 2408.

Closing date: 16 February, 1979.

UNIVERSITY OF SOUTHAMPTON

Medical Oncology Unit

Applications are invited for the post of

RESEARCH ASSISTANT

in the Medical Oncology Unit at Southampton General Hospital to work on immunological aspects of cancer and other diseases. Preference will be given to candidates who have either some experience of immunological and radio-isotope techniques or an honours degree in biochemistry or a related subject. The successful applicant will be expected to start as soon as possible.

The post is available for $2\frac{1}{2}$ years in the first instance.

Salary on scale 1B, £3384-£4882 per annum.

Applications (3 copies) should be sent to Mrs P. Vaughan-Smith, The University, Southampton SO9 5NH, as soon as possible quoting reference 1054/R/NSc.

THE UNIVERSITY OF MANCHESTER

LECTURER IN GEOLOGY

Applications are invited for this post from persons with an interest in Economic Geology, with particular reference to Ore Deposits. Initial salary range pa: £3883-£4631. Particulars and application forms (returnable by 22 February) from the Registrar, The University, Manchester M13 9PL. Quote ref: 12/79/NS.

Computing for High Energy Physics

We are looking for young and enthusiastic physicists or computer scientists to join the Data Handling Group of the Rutherford Laboratory's High Energy Physics Division. Members of the group are working on all aspects of the computing required for research into elementary particle physics, both at the Laboratory and at international research laboratories in Geneva and Hamburg. Current projects include:-

real-time programming for data acquisition and contro' using the DEC VAX-11/780, GEC 4080, etc.

data reduction and analysis on the Laboratory's dual IBM 360/195's.

system software development for Laboratory designed special purpose processors.

Candidates should have a good honours degree in physics, mathematics or computer science. Depending on qualifications and experience salaries will be within the following scales:

Scientific Officer £3,037-£4,724
Higher Scientific Officer £4,388-£5,829

There is a contributory superannuation scheme and generous leave and sick leave allowances.

The Rutherford Laboratory, situated on the Berkshire Downs, is about 18 miles south of Oxford. It has its own restaurant and recreational facilities. Shops, banking facilities, hostels and further sports and recreational clubs are available on the adjoining AERE Harwell Site. Daily travel is available from most of the neighbouring towns and villages direct to the Laboratory.

Telephone Jane Griffiths in the Personnel Group on Abingdon (0235) 21900 Ext. 510, or write to her quoting reference No. VN766. Closing date for applications; March 2nd 1979.

RUTHERFORD
Science Research Council
Rutherford Laboratory, Chilton, Didcot, Oxfordshire OXII OQX. Tel Abingdon 21900

LONDON BOROUGH OF BROMLEY

BROMLEY COLLEGE OF TECHNOLOGY

DEPARTMENT OF APPLIED BIOLOGY

Technician T2

Technician required for preparation work for practical classes running at this college.

Work will include basic biochemistry and specialisation either in Applied Biology or Medical Laboratory Sciences.

Qualifications: HNC Applied Biology or Medical Laboratory Sciences or equivalent with relevant laboratory experience.

Salary: £3564–£3936 inclusive of London Weighting.

Apply to: **Chief Technician, Applied Biology Department, Bromley College of Technology, Rookery Lane, Bromley, Kent. Tel. 01-462 6331 Ext. 29.**

YOUNG WRITER

required to join the Development Department of the International Tin Research Institute. The duties will include asssistance in the preparation of articles for the Institute's periodicals as well as participating in the general activities of the Department. This position would suit a graduate in metallurgy, engineering or a related subject. A recent graduate would also be considered. A principal consideration is a lively general interest in modern technology, and the ability to express this clearly and concisely. Salary subject to qualifications and experience.

Applications, with curriculum vitae should be addressed to Mr C. J. Evans, International Tin Research Institute, Fraser Road, Perivale, Greenford, Middlesex.

ROYAL FREE HOSPITAL SCHOOL OF MEDICINE

(University of London)

Department of Biochemistry & Chemistry

TECHNICIAN

is required, with experience of organic synthesis and spectroscopic techniques, to work with a team studying biomembrane structure and function.

Salary on Whitley Council Scale.

Application forms, which are available from the School Secretary, RFHSM, 8 Hunter Street, London WC1N 1BP (or telephone 01-837 5385 Ext 10), should be returned by 22 February, 1979.

ST MARY'S HOSPITAL MEDICAL SCHOOL

(University of London)
Paddington, London W2 1PG

SCIENTIFIC OFFICER (PART-TIME)

required in Department of Paediatrics to work on development of electro-chemical methods of enzymatic analysis. Two-day week by arrangement. Starting salary £1446 pa inclusive. One year appointment in first instance. Apply, The Secretary, at above address quoting Ref P/DR/PT.

LANCING COLLEGE WEST SUSSEX

520 pupils: 300 VI Form

CHEMISTRY graduate

required for September 1979 to teach to scholarship and "A" level. Desire to participate in extra curricula activities essential. Curriculum vitae and names of two referees to the Head Master.

UNIVERSITY OF LONDON CHAIR OF AGRICULTURAL BOTANY AT WYE COLLEGE

The Senate invites applications for the above Chair. Applications (10 copies) should be received by the Academic Registrar (NS), University of London, Malet Street, London WC1E 7HU, from whom further particulars should first be obtained. Closing date 2 March, 1979.

FLATFORD MILL FIELD CENTRE

COOK

required, under 35, February-November, for resident students (mainly adults). Please write for further details, giving some information on your qualifications/experience, to Mrs M. Bingley, Flatford Mill Field Centre, East Bergholt, Colchester CO7 6UL.

PRODUCTION TRAINEES

(F.I.L. is a Unilever associated company)

Food Industries Limited is a rapidly expanding company which manufactures high quality food flavours and other functional food improvers.

We are looking for recent scientific or technical graduates who have the ability to make a career in production management.

The successful candidates will be given intensive on the job training, tailored to their individual requirements augmented with project work and formal training courses. Career progression will be dependant upon ability and work achievement. The first career step is likely to be into a supervisory position with responsibility for several production units engaged in the processing of natural products and fine chemicals.

The commencing salary will be £3,900 p.a. and the conditions of service are as you would expect of a modern and progressive Unilever company.

Please write or telephone for an application form to:

Mr J.L. Thornton,
Company Personnel Manager,
FOOD INDUSTRIES LTD,
Bromborough Port, Wirral,
Merseyside, L62 4SU. Tel: 051-645 2060.

INHALATION TOXICOLOGIST

who wishes to widen his/her career path by assuming a senior role as second in command to the head of department as well as fulfilling the exacting but varied responsibilities of project management including proposal activity, client liaison, project co-ordination and report writing.

The Inhalation Department undertakes the safety evaluation of pharmaceuticals, agrochemicals and industrial chemicals.

The vacancy has come about by the increase in work in this department. It requires a graduate with at least 2-3 years' experience of inhalation work in a contract or industrial research establishment, who can not only prove competency in the above aspects of project management but who also has the ability to maintain a stimulating and innovatory environment by the input of new ideas and methods.

For further details of the position, the company, and Harrogate, please telephone:

BARBARA GRANT,
HAZLETON LABORATORIES EUROPE LIMITED,
OTLEY ROAD, HARROGATE.
TELEPHONE 0423 67265.

HAZLETON
LABORATORIES EUROPE LTD

Severn Trent Water Authority invite applications from suitably qualified men and women for the following Headquarters post:

Area Hydrogeologist

(REF W22)

£5133—£5493 p.a. or £5682—£6084 p.a. (inclusive of supplement).

Based at Nottingham in the Trent Area Unit of the Resource Management Section of the Directorate of Operations. The Area Hydrogeologist will work with a team of professional and technical staff responsible for hydrological and hydrogeological services for the whole of the Trent catchment. The duties of the post will include a detailed involvement with other headquarters and divisional staff on all aspects of groundwater resources development, management and protection. The team is also responsible for consultations on water abstraction and waste disposal licences and on planning applications as they relate to groundwater and the successful applicant will be expected to contribute in these areas.

Candidates should have appropriate professional qualifications, be well motivated and be capable of working on their own initiative.

Application forms and further details are available from the **Regional Personnel Manager, Severn Trent Water Authority, Abelson House, 2297 Coventry Road, Sheldon, Birmingham B26 3PU.**
Telephone; 021 743 4222 ext 76 or 77.
Closing date: 19 February, 1979.

SEVERN TRENT WATER

Tropical Products Institute
Culham, Oxon

Food Technologist

. . . to join the Non-Cereals Section of the Institute working on processing problems for a wide range of fruit and vegetables. In addition the food technologist will take an active part in the current work of the Section, which includes various projects in sugar and starch processing and the maintenance of formal and ad hoc heat preservation training programmes. The Section has extensive facilities including a transportable cannery used for training, varietal research and local preparation of bottled and canned samples for marketing trials in producing areas. There are opportunities to undertake overseas project work.

Candidates, normally aged under 30, must have a degree or equivalent in an appropriate discipline. Practical experience of commercial food processing is highly desirable. *Final Year Students may apply.* Appointment as Higher Scientific Officer (£4100-£5450) or Scientific Officer (£2840-£4410) according to qualifications and experience. Promotion prospects. Non-contributory pension scheme.

For further details and an application form (to be returned by 23 February 1979) write to Miss C A Hall, Tropical Products Institute, 127 Clerkenwell Road, London, EC1R 5DB. *Please quote ref: SA/96/JD.*

Science Group
CIVIL SERVICE

SYNTHETIC ORGANIC CHEMIST

(GRADUATE/HND)

PHARMACEUTICAL R&D

We require a Synthetic Organic Chemist to work in our Process Research and Development Department.

The present vacancy involves working in a team chiefly concerned with the discovery and development of chemical syntheses leading to new therapeutic agents.

We are particularly interested in people with either a BSc/GRIC or HNC/HND. Although some industrial experience would be an advantage, applications are also invited from those who have recently qualified.

Conditions of employment include a competitive salary, flexible working hours, a good pension scheme and assistance with relocation expenses.

For an application form please write or telephone Miss Cathy Mason, Fisons Limited, Pharmaceutical Division, Bakewell Road, LOUGHBOROUGH, Leicestershire LE11 0QY. Tel No 0509 66361 quoting reference number RD27/NS.

FISONS

1978

PHARMACEUTICAL DIVISION

Residue Chemist and Metabolism Chemist

We have vacancies in the Metabolism and Residues Section of our Environmental Sciences Group for a residue chemist and a metabolism chemist. The residue chemist will work in a team developing analytical methods for various pesticides in a variety of substrates. The metabolism chemist will be involved in studying the fate of pesticides on crops, in animals and in the environment.

Our modern, extensively equipped laboratories contain the latest instrumentation including GLC with various selective detectors, GC-MS, HPLC, and various radiotracer techniques.

We require recent graduates in Chemistry or a related subject. Some knowledge and/or experience of analysis of organic compounds or radiotracer techniques would be an advantage.

The successful candidates will be involved in a variety of projects evaluating the safety of pesticides. As the work involves contact with people from a range of disciplines, the appointed persons should have outgoing and interesting personalities.

We offer good salaries and fringe benefits include membership of the ICI Profit Sharing Scheme and Pension Fund Scheme.

If you are interested in applying for one of these posts please write for an application form to:

Mr S. R. Stephenson, Personnel Officer,
ICI Plant Protection Division, Jealott's Hill Research Station, Bracknell, Berkshire.

Ref No. 79/Met and Res

ICI

Plant Protection
Division

The Burgoyne Committee on Offshore Safety

The Secretary of State for Energy has recently announced the appointment of this Committee, with the following terms of reference:

> "To consider so far as they are concerned with safety, the nature, coverage and effectiveness of the Department of Energy's regulations governing the exploration for and development and production of oil and gas offshore and their administration and enforcement. To consider and assess the role of the Certifying Authorities. To present its report, conclusions and recommendations as soon as possible."

The Committee needs factual information, views and suggestions on the matters covered by these terms of reference.

Anyone wishing to submit evidence should do so by **16 March 1979.** Submissions should be sent to Mr David Pogson, Secretary, Offshore Safety Inquiry, Department of Energy, Room 1379, Thames House South, Millbank, London SW1. (Telephone: (01) 211-6627 or 4354) from whom further information about the scope of submissions can also be obtained.

SOUTH GLAMORGAN HEALTH AUTHORITY (T)
CARDIFF ROYAL INFIRMARY

BASIC GRADE PHYSICIST OR ELECTRONICS ENGINEER

SALARY: £2991—£4275 (candidates holding 1st or 2nd class Honours Degree will start on a minimum of £3486 p.a.)

A Scientist is required to join the Bioengineering Unit to provide scientific and technical services to the Urology Department at Cardiff Royal Infirmary in the field of Urodynamics.

This is a new post and will require close links with Clinical colleagues, participation in patient measurements and the development of measuring techniques.

The successful applicant will be a Graduate Physicist or Electronics Engineer. Previous experience in the Medical Physics or Bioengineering field is not essential but would be an advantage. An initial training period in the USA is likely.

For further details contact: Dr P. A. Payne, Principal Physicist, Tel. Cardiff 755944 Ext. 2004 or Mr T. Stephenson, Consultant Urologist, Tel. Cardiff 492233 Ext. 498

Application forms from: Personnel Department, University Hospital of Wales, Heath Park, Cardiff Cf.4 4XW
Closing Date 23 February, 1979.

UNIVERSITY OF DURHAM

DEPARTMENT OF CHEMISTRY

RESEARCH TECHNICIANS (2 Posts)

Required to work with the Physical Chemistry Research Group on study of reaction rates in solution.

Minimum qualification ONC in Sciences or equivalent and 5 years experience in full-time laboratory work. Salary at an appropriate point on the University Technician Grade 3 Scale (£2688–£3060 under review) according to qualifications and experience.

Application forms and further details from:

The Personnel Department,
University Office,
Old Shire Hall,
Durham
DH1 3HP.

Closing date for completed forms, 12 February, 1979

SYBRON|Taylor

We are urgently seeking a

CHEMISTRY GRADUATE

to fill a vacancy in our Applications Laboratory. Our product range includes Oxygen Analysers and Process Gas Chromatographs and a knowledge of these subjects would be helpful but not essential. The post will involve a certain amount of travel both in the UK and abroad and would suit someone with an interest in analytical instrumentation.

We offer a competitive salary, contributory pension scheme, free life insurance and four weeks annual holiday.

Please write or telephone for further details to:

The Personnel Department
Taylor Instrument Analytics Limited
Crowborough
Sussex

Tel: Crowborough 2181

ST THOMAS' HOSPITAL
London SE1

MEDICAL PHYSICS TECHNICIAN III

To assist in the use of radionuclides for a wide range of clinical work in the Department of Nuclear Medicine.

Applicants must have ONC, HNC or similar qualifications together with previous experience in this or a closely related field.

Salary Scale:— £4098—£5142 (inclusive).

For further information contact the **Secretary (01) 928 9292 Ext. 2384 (Mrs Gaunt).** For job description and application form contact **Personnel Officer (01) 928 9292 Ext. 2779.**

UNIVERSITY OF OXFORD RESEARCH OFFICERSHIPS IN NUCLEAR AND PARTICLE PHYSICS

The University proposes to appoint three Research Officers in the Department of Nuclear Physics for a period of three years, from 1 October, 1979, or earlier if possible. Salary according to age on the University Lecturer scale (under review) £3883 to £8257. One post will be filled in experimental high energy physics and two in experimental nuclear structure physics. Further particulars may be obtained from the department.

Applications (one typed copy) including a statement of qualifications, publications and the names of two referees, should reach Professor K. W. Allen, Department of Nuclear Physics, Keble Road, Oxford OX1 3RH, by 15 March, 1979. (Revised.)

LISTEN TO THIS

We are looking for a young—early twenties—writer to join the staff of one of our Hi-Fi magazines. This post would suit either a journalist with a proven interest in and knowledge of the subject, or someone with a technical/industrial background and some obvious writing ability. Salary to NUJ rates plus for right person. Applications to **Hugh Johnstone, Haymarket Publishing Ltd., Craven House, 34 Foubert's Place, London W1A 2HG.**

NEW PRODUCT DEVELOPMENT MANAGER

c. £5,000 + Car.

Southalls (Birmingham) Limited are a principal division of the Smith & Nephew Group of Companies and are manufacturers of some of the leading brands in the hospital disposables and sanitary protection market. We now wish to appoint a Manager responsible for the development of new product ideas, especially in the field of hospital disposables. He or she will be responsible also for product specifications and patent information. Applicants should ideally be aged 25 - 35 years and a graduate in a relevant science discipline.

Experience should include at least 2 years in either industry, nursing or post graduate university position dealing with natural or synthetic fibres. A knowledge of raw materials including textiles, plastics, pulp and adhesives etc., and familiarity with likely markets would be an advantage.

You will be controlling a small specialised department for all day-to-day activities for which a knowledge of laboratory test methods would be advantageous.

We are offering an excellent salary as indicated, along with good conditions of work and the normal big company benefits. A Company car will be provided.

Please write in the first instance enclosing brief career details to :- Charles Fellows, Personnel Manager, Southalls (Birmingham) Limited, Alum Rock Road, Birmingham B8 3DL.

This position is open to both men and women.

Smith & Nephew-Southalls Limited
Service to Hospitals

S&N

MANCHESTER POLYTECHNIC

Institute of Advanced Studies
RESEARCH ASSISTANT

to join a small team engaged on the design of an Interactive Software System for Built Form Generation.

The research is concerned with developing an interactive program to investigate and optimise building layouts. The development is based on a PDP10 Fortran program from which a subset will be rewritten in Basic and implemented on a Tektronix 4051 graphics system.

This temporary post is provided through a Science Research Council grant and is tenable for two-and-a-half years at a starting salary of £3468. Candidates must hold a science degree and be able to demonstrate computing and mathematical skills. An opportunity to register for a higher degree exists.

For further particulars and application form (returnable by 19 February, 1979) please send a self-addressed envelope marked "S/803" to the Secretary, Manchester Polytechnic, All Saints, Manchester M15 6BH.

RANGE ECOLOGY— LIVESTOCK MANAGEMENT

A range ecologist is required for a one-year study of domestic and wild herbivores in eastern Africa. Salary £4000-£8000 according to age, qualifications and experience.

Preference will be given to an applicant with experience of African herbivores and rangelands or the management of livestock under tropical conditions. Ability to work under isolated conditions essential. Accommodation and living expenses on site will be met.

Applications with curriculum vitae and names of two referees to be submitted by 15 February to Dr D. Jones, Department of Veterinary Science, Zoological Society of London, Regent's Park, London NW1 4RY.

ORIELTON FIELD CENTRE

STUDENT HELP REQUIRED

Are you an unemployed biology or geography graduate or a student waiting to go up to University. If so, why not come and work as a domestic assistant at a Field Centre for six months starting 1 February. It's a great experience. Apply The Warden, Orielton Field Centre, Pembroke, Dyfed SA71 5EZ. Telephone: Castlemartin 225.

TEAM LEADER

–REPEAT PREPARATIONS

This is a vital role at our R&D Laboratories in Loughborough.

Repeat Preparation is a small unit of chemists and technicians primarily involved in providing a wide range of intermediates for our Medicinal Chemists. There is a high throughput of compounds and the team frequently works to tight schedules.

To handle the job we are looking for a Chemist with a degree or equivalent who has had at least three years' post-graduate experience. Equally important is experience of directing the work of others.

Conditions of employment include a competitive salary, a good pension scheme, flexible working hours and assistance with relocation expenses where appropriate.

If you are interested please contact:
Mr Bryan Johnston, Personnel Operations Manager, Personnel Department, Fisons Limited, Pharmaceutical Division, Bakewell Road, LOUGHBOROUGH, Leicestershire LE11 0QY. Tel No. 66361, quoting reference number RD21/NS.

FISONS
PHARMACEUTICAL DIVISION

John Laing Research & Development Limited is one of the largest privately owned R&D organisations within the construction industry. We now have the following vacancies in the Energy Group based in Borehamwood, Herts.

Senior Technician

To undertake electrical and electronic tests in the Energy Department and prepare comprehensive data and laboratory reports. Candidates must have good basic knowledge of data logging and electronic test equipment, together with practical experience of general fault location. Applicants, aged 25/40, should have TICE or THNC, or alternatively five years' relevant experience.

Junior Technician

To assist generally in the laboratory in carrying out routine tests under supervision. Should be able to prepare and present test data and notes in neat and tidy manner. Candidates, aged 18/25, should be of GCE 'O' level educated standard. Some previous experience in in an R&D laboratory would be useful but not essential.

Attractive salaries will be offered. Other benefits include four weeks' three days' annual leave, pension scheme and free life assurance.

Please write or telephone for an application form to:

D. C. Madden, Personnel Manager, Group Personnel Services, John Laing Limited, Page Street, Mill Hill, London NW7 2ER.

Tel: 01-906 5202.

LAING

CHIEF TECHNICIAN (GRADE 7)

required in School of Education, University of Reading, to head team of 4 technicians providing service for teaching and research. Facilities include general labs, photographic lab, language lab, TV studio and A/V aids lab and other specialised workrooms and labs. HNC or equivalent qualification desirable with substantial appropriate experience. Salary in scale £4254-£4782 pa (under review). Apply for further details, quoting Ref. T.S. 07A, to Assistant Bursar (Personnel), University of Reading, Whiteknights, Reading, Berks RG6 2AH.

UNIVERSITY MARINE BIOLOGICAL STATION MILLPORT

Isle of Cumbrae KA28 0EG

Applications are invited for technical posts in the grades UTS3 and UTS1B. Further details and application forms may be obtained from the Station Secretary at the above address to whom completed forms should be returned not later than 16 February, 1979.

As a result of expansion we have a vacancy for a

DESK EDITOR

for work on highly specialized scientific journals. Candidates must have had university level training in the Physical Sciences or Engineering. A concern for literate communication and excellent knowledge of the English language are essential, as is the ability to work precisely and efficiently under pressure. Previous publishing experience is necessary. Excellent prospects for the right candidate.

Applicants should contact the Editor: **Editorial Office (U.K.) of Elsevier Sequoia, Mayfield House, 256 Banbury Road, Oxford OX2 7DH.**

ELSEVIER

UNIVERSITY OF BRISTOL DEPARTMENT OF GEOLOGY

Rock-section Technician Wanted

Applications are invited for a person to take charge of the rock-cutting workshop. The appointed person will have had several years experience in this type of work together with some educational qualifications.

The position carries a salary of £3186-£3720 per annum (Grade 5) (scale under review). Applications, including the names of two referees, to: **The Superintendent, Department of Geology, Queens Building, University Walk, Bristol BS8 1TR.** To be received within two weeks of this advertisement appearing.

ROEHAMPTON INSTITUTE OF HIGHER EDUCATION

TECHNICIAN (CHEMISTRY)

required a.s.a.p. at Whitelands College, West Hill, London SW15 3SN. City & Guilds Cert. (or an equiv. qual. in chemistry) preferred, or previous technical experience. Salary within NJC Tech I scale (£2523 at age 18 years rising by 7 increments to £3230 pa incl. LA). For details and application form apply to College Secretary.

IMPERIAL COLLEGE

Wolfson Unit

For solid state Ionics

The above unit has been established to provide a focus for the development, characterisation, and application of solid state ionic materials. These materials are already being incorporated into solid state batteries, electrochromic display devices, and chemical information transducers. Rapidly increasing industrial applications have produced requirements for new materials and fabrication techniques to meet demands for improved technical and economic performance. The present expansion of the Wolfson Unit is principally concerned with extending and improving available fabrication facilities and expertise with particular emphasis upon thin film and coating techniques. This programme required abilities to undertake investigations in the following areas:

1. Fabrication and evaluation of polymeric solid electrolytes produced as thin films.
2. Preparation and evaluation of novel inorganic solid electrolytes.
3. Preparation and examination of thin inorganic coatings using chemical vapour deposition and R.F. plasma techniques.
4. Fabrication and characterisation of thin films of dielectric compounds using evaporation and sputtering techniques.
5. Microstructure property investigations associated with the development of strong zirconia based solid electrolytes.

Five post-doctoral positions are available, one of which will be a senior post with the status of Wolfson Fellow who will be expected to assist in the management of the Wolfson Unit. The salaries will be on the scale £4359–£7005 per annum including London allowance (under review), plus superannuation, and financial support is available for three years.

In addition it is hoped to appoint at least one Research Officer to provide assistance in one or more of the above investigations.

Applications containing details of relevant experience and the names of two referees should be sent to Dr B. C. H. Steele, Department of Metallurgy and Materials Science, Imperial College, London SW7 2BP.

CITY OF GLASGOW DISTRICT COUNCIL

MUSEUMS AND ART GALLERIES

Conservation Officer (Scientific)

Salary Scale: £3279 — £4773*

Applications are invited for a vacancy in a conservation science laboratory. Candidates should possess a good honours degree in physics, chemistry, metallurgy, materials science or a related subject. Museum or research experience would be advantageous.

The successful candidate will work closely with a large conservation staff and will be expected to develop methods of conservation treatment and apply scientific techniques into research into museum objects.

* Including Supplement

Superannuation, Sick Pay and Staff Life Assurance Schemes in operation. Removal expenses, legal fees and lodging and subsistence allowances payable in appropriate cases.

Appointment subject to medical fitness. Local authority salary and conditions apply.

Further details and an application form may be obtained from the Director, Art Gallery and Museum, Kelvingrove, Glasgow G3 8AG, Completed application forms to be returned by Friday 16 February, 1979.

(PLEASE QUOTE REF. NS/5/79.)

LINCOLN COLLEGE
(University College of Agriculture) New Zealand
LECTURER IN CROP PHYSIOLOGY

Applications are invited for the position of Lecturer in the Department of Plant Science. Applicants should have qualifications and research experience in crop physiology, preferably combining a sound knowledge of physiological principles with personal experience of crop or pasture production. Teaching at undergraduate and postgraduate levels will necessitate competence in such topics as photosynthesis, water relations. competition, etc.

Commencing salary according to qualifications and experience. Present salary scale is: NZ$11 529-$14 250. Travel and removal expenses are reimbursed up to specified limits. New Zealand Government Superannuation is available.

Initial enquiries may be made to the following now on study leave in England: Dr P Jarvis, Plant Physiology Department, University of Sussex, or Dr W. R. Scott, Plant Breeding Institute, Cambridge.

Conditions of Appointment are obtainable from the Association of Commonwealth Universities (Appts.), 36 Gordon Square, London WC1H 0PF, or from the Registrar of the College.

Applications close on 16 April, 1979.

LOTHIAN HEALTH BOARD

BASIC GRADE CYTOGENETICIST

Applications are invited from science graduates for the above post based at the Department of Pathology, Royal Hospital for Sick Children, Edinburgh. Experience in human cytogenetics desirable.

All types of cytogenetic investigation are undertaken including the prenatal diagnosis of chromosome disorders, blood culture analysis, bone marrow investigation and the karyotyping of post mortem and spontaneous abortion material. A broad training in cytogenetics would be afforded.

Arrangements to visit the department may be made by telephoning 031-667 1991, ext 270.

Salary scale £2991 per annum to £4899 per annum with placement according to qualifications and experience.

Applications, which should be typewritten, giving particulars of age, qualifications and previous experience together with the names and addresses of two referees should be lodged with the **Secretary, 11 Drumaheugh Gardens, Edinburgh, EH3 7QQ,** by 22 February, 1979.

M.R.C. CLINICAL RESEARCH CENTRE
(Northwick Park Hospital)
Watford Road, Harrow, Middx. HA1 3UJ

A SENIOR POST DOCTORAL PHYSIOLOGIST

This is a new appointment to work with Dr Michael Halsey on high pressure studies in non-human primates. The successful applicant will take a major part in the development of a national pressure chamber facility which will be used for studying the high pressure neurological syndrome and its amelioration by anaesthetics.

Potential applicants are invited to visit informally the Clinical Research Centre and to discuss their research ideas with Dr Haisey before applying.

This is a limited term appointment and the salary will be in the range £4832—£6530 (including London Allowance). Dr Halsey can be contacted for further details (tel: 01-864 5311 ext. 2452) and application forms are obtainable from Mrs J. Tucker-Bull, quoting ref. No. 101/1/428i.

KING'S COLLEGE HOSPITAL MEDICAL SCHOOL
(University of London)
Denmark Hill, London SE5 8RX
Chest Unit
LECTURER

Applications are invited from suitably qualified graduates, with or without a medical degree, for the post of lecturer in this Medical School.

Duties will include undergraduate teaching, and the Lecturer will be expected to participate in the Department's wide and active research interests in fields such as asthma and emphysema.

A particular interest in lung mechanics and exercise physiology would be an advantage. For medically qualified candidates, the post will carry an appropriate honorary grading in the King's Health District (Teaching) and there will be opportunities for pursuing clinical medicine on the wards and in outpatient clinics.

Salary will be on the scale for Clinical Lecturers £4986-£7393 plus £354 London Weighting Allowance or non-clinical Lecturers £3883-£7754+£450 London Weighting Allowance according to qualifications and experience.

Applications (4 copies) giving curriculum vitae and the names and addresses of 3 referees, should be sent to the Secretary of the Medical School, from whom further details may be obtained.

Closing date 3 March, 1979.

ELECTRONIC ENGINEERS/ SCIENTISTS including final year students

Communications Systems R&D -a vital intellectual challenge

Government Communications Headquarters is a large organisation undertaking research, development and production in connection with every type of communication system including long range radio communications, satellite and microwave systems, and telephony. Laboratories are modern and well equipped and are supported by extensive computing and other facilities. GCHQ offers graduates a wide range of intellectually challenging work, combined with opportunities for overseas contact and travel, and, a wide range of social and cultural activities.

These posts are concerned with a wide range of problems associated with the development and implementation of radio and communication systems. The work ranges from the study of electro-magnetic propagation mechanisms and modulation techniques to the design of novel radio receiving systems with their associated aerials and data processing systems. In addition various methods of providing security for communication systems are investigated and special equipment is developed for this purpose. The electronics engineers/scientists appointed will join project teams to gain experience in a number of areas before becoming team leaders.

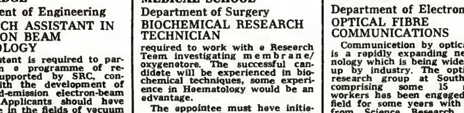
Both your training and subsequent career will be centred in Cheltenham—an elegant town, set in the beautiful Cotswold countryside.

Many of the vacancies require a good honours degree or equivalent in Electronics Engineering, Physics or a related scientific subject, but for others a pass degree or HNC would be acceptable.

Appointment will be as Higher Scientific Officer (£4100—£5450) or Scientific Officer (£2840—£4410) according to qualifications and experience. Promotion prospects. Non-contributory pension scheme. Flexible working hours.

For further details and an application form (to be returned by 21 February, 1979) write to Graduate Appointments Officer, GCHQ, Oakley, Priors Road, Cheltenham GL52 5AJ. *Please quote ref: SA/16/ED.*

GCHQ Cheltenham



UNIVERSITY OF DUNDEE

DEPARTMENT OF ELECTRICAL ENGINEERING AND ELECTRONICS

There is a vacancy for a

SCIENTIFIC OFFICER

to work with the academic staff of the above Department and to play a major part in the planning and execution of research in a variety of important areas including micro-electronics and micro-processor technology.

The successful candidate will probably have an appropriate Honours degree qualification and research experience but could be someone with an appropriate professional qualification, and Higher degree, and extensive experience in laboratory work

Salary scale £3384 to £5604 with appropriate initial placing.

Applications, containing details of age, qualification and experience and the names of two referees should be sent by 22 February, 1979, to the Secretary, The University, Dundee DD1 4HN. Please quote ref: EST/22/79H.

ST THOMAS'S MEDICAL SCHOOL

(University of London)
London SE1 7EH

Department of Community Medicine

LECTURER IN MEDICAL STATISTICS

Applications are invited for the post of Lecturer in the statistics section of this multidisciplinary Department. The work will involve the development and application of statistical techniques for analysing data from large scale surveys and other studies conducted by the Department. Development of appropriate computer programmes will sometimes be necessary. The Department has access to the University of London computing facilities.

Experience in medical statistics will be an advantage, but is not essential, as will experience in operational research.

The salary will be on the University Lecturer scale, currently £4133-£7754 plus £450 London Allowance.

Applications with curriculum vitae and names of two referees to Professor W. W. Holland at the above address within two weeks of this advertisement.

DURHAM COUNTY CONSERVATION TRUST

require a

CONSERVATION OFFICER

to further the conservation aims of the Trust in such ways as organising a survey of sites of particular ecological importance, acquiring new nature reserves and assisting with liaison work with outside bodies. Applicants should have a good grounding in natural sciences and preferably some conservation experience. It is hoped that the successful candidate will be able to take up the appointment within three months. Salary to be in the range £3000 to £3500 depending on experience.

Further details can be obtained from the Administrative Officer, Durham County Conservation Trust, 52 Old Elvet, Durham. Closing date for applications 28 February, 1979.

ALTERNATIVE COMMUNITIES MOVEMENT

join it, send SAE for details to The Teachers Community (02), 18 Garth Road, Bangor, North Wales.

UNIVERSITY OF CAMBRIDGE

Department of Engineering

RESEARCH ASSISTANT IN ELECTRON BEAM TECHNOLOGY

An assistant is required to participate in a programme of research, supported by SRC, concerned with the development of novel field-emission electron-beam systems. Applicants should have expereince in the fields of vacuum physics and electronics, and should preferably hold a PhD degree, or possess substantial postgraduate experience, in a relevant field. Tenure will be for a maximum of two years.

Pensionable salary will be in the range: £4133-£5367 pa, depending on age and experience.

Further particulars and application forms may be obtained from the Secretary, Faculty of Engineering, University of Cambridge, Trumpington Street, Cambridge CB2 1PZ.

ROYAL POSTGRADUATE MEDICAL SCHOOL

Department of Surgery

BIOCHEMICAL RESEARCH TECHNICIAN

required to work with a Research Team investigating membrane/oxygenators. The successful candidate will be experienced in biochemical techniques, some experience in Haematology would be an advantage.

The appointee must have initiative and be able to work with minimal supervision. Minimum qualifications HNC or equivalent. Appointment until 31 December, 1980, with the possibility of extension thereafter.

Salary will be up to £4621, initial starting salary dependent on experience and qualifications.

Application form and further details may be obtained from the Personnel Office, Royal Postgraduate Medical School, 150 Du Cane Road, London W12 0HS, quoting reference number 3/321/NS.

UNIVERSITY OF SOUTHAMPTON

Department of Electronics

OPTICAL FIBRE COMMUNICATIONS

Communication by optical fibres is a rapidly expanding new technology which is being widely taken up by industry. The optical-fibre research group at Southampton, comprising some 15 research workers has been engaged in this field for some years with support from Science Research Council, industry and elsewhere and wishes to expand the present research team. Applications are therefore invited for a number of research fellowships, including a Pirelli Fellowship, at salaries linked to the scale for Lecturers. Persons with an interest in any aspect of the subject are eligible.

Applications, giving a brief curriculum vitae and the names of two referees, should be sent to D. A. S. Copland, The University, Southampton SO9 5NH, quoting reference 186/R/NSc.

MEDICAL REPRESENTATIVES

Experienced Representatives, Science Graduates and people from a Para-Medical background are needed for our clients. Excellent salaries plus car, plus commission are offered as well as many opportunities for career advancement.

BISHOPSGATE EMPLOYMENT AGENCY

80 Bishopsgate, London EC2N 4AU
01-638 0523

National College of Food Technology
(University of Reading)

PHYSICS TECHNICIAN GRADE 3

Applications are invited from suitably qualified persons to carry out a fairly wide range of duties including the maintenance and construction of certain laboratory equipment for research and teaching and assistance during practical classes. Practical experience in electronics is essential. Salary range £2688—£3060 + £275 London Weighting (under review).

Application forms from the Secretary, National College of Food Technology, St. George's Avenue, Weybridge, Surrey.

ROYAL POSTGRADUATE MEDICAL SCHOOL

Department of Surgery

HISTOPATHOLOGY RESEARCH TECHNICIAN

required for two years in the first instance (with possibility of extension) to work with an orthopaedic team of surgeons investigating mineral transport in bone. To confirm the dynamic studies histological sections of canine tibia are required.

The successful candidate will be experienced in histopathological techniques, some experience in electron microscopy and autoradiography techniques would be an advantage.

The appointee must have iniative and be able to work with minimal supervision.

Salary will be up to £4133 a year, starting salary dependent on experience and qualifications.

Application forms and further details may be obtained from the Personnel Office, Royal Postgraduate Medical School, 150 Du Cane Road, London W12 0HS, quoting reference number 3/285/NS.

WELSH NATIONAL SCHOOL OF MEDICINE
(University of Wales)

DENTAL SCHOOL

EXPERIENCED ELECTRON MICROSCOPE TECHNICIAN

required for the AEI 6B TEM and ISI Super SEM IIIA Electron microscope at the Dental School.

Salary within the scale £3654–£4365 for University Technical Staff, Grade 6; starting salary dependent upon qualifications and experience. Pension scheme.

Applicants wishing to visit the Dental School should contact Mr R. Allison (Cardiff 755944 ext. 2546). Further particulars and application forms (quoting Ref No M16/D21) available from the **Registrar and Secretary, Welsh National School of Medicine, Heath Park, Cardiff CF3 4XN (Ext 2073)** to whom applications should be submitted as soon as possible.

THE GAME CONSERVANCY

Applications are invited for a three year comparative study of the population ecology of Mallard and Tufted duck, in wet gravel workings. To start for the 1979-1980 academic year. Candidates should anticipate a good first degree and will be expected to register for a PhD. A strong interest in bird population studies is essential. The post will be based on a study area with laboratory facilities in North Buckinghamshire. Applications, with a curriculum vitae and names of two referees should be sent to Dr G. R. Potts, Research Director, The Game Conservancy, Fordingbridge, Hampshire. Closing date 16 March, 1979.

Developmental Toxicology

IRI has the following vacancies in this area for both senior and junior staff:

SECTION MANAGER, MAMMALIAN MUTAGENESIS:

To supervise and undertake a range of studies in mammalian mutagenesis from protocol to final report. These studies include, cytogenetic analysis in mammals and cultured cells, micronucleus tests, sperm abnormalities tests, dominant lethal tests and heretable translocation tests. The Section Manager will also be involved in staff organisation and training. Candidates should possess a higher degree and be fully experienced in this field (Ref. 3303).

SECTION MANAGER, REPRODUCTIVE TOXICOLOGY:

To supervise and undertake a full range of reproductive studies, including teratology and fertility studies from protocol preparation to final report, including staff organisation and training, client contact and overall responsibility for the efficient operation of the Section. Candidates should possess a PhD and several years' experience of work in Teratology (Ref. 2603).

RESEARCH ASSISTANTS, CYTOGENICITY (2):

To assist in the testing of substances for mutagenic potential in mammals, including dosing, handling and assessment. Candidates should have a degree or equivalent in a relevant biological science and laboratory experience in this field (Ref. 3306).

RESEARCH ASSISTANTS, MUTAGENICITY (2):

To assist in testing of substances for various types of toxicity *in vitro*. Candidates should preferably be graduates with training in a relevant biological science or laboratory experience in microbiology (Ref. 2315).

ANIMAL TECHNICIANS (4):

To participate in rodent toxicology studies, involving the dosing and observation of rats and mice, the collection of body fluids and general husbandry for experimental animals. Candidates should have experience in animal handling and preferably hold a Home Office licence and/or AIAT (Ref.2218).

IRI is located in a rapidly developing area of the UK, within easy reach of Edinburgh and the surrounding countryside. The benefits associated with these posts, which include pension scheme, free life assurance and relocation assistance in some cases, are of the standard offered by a modern expanding company.

Application forms, quoting the appropriate reference are available from:

IRI

Miss J. M. Dunbar,
Inveresk Research International,
Inveresk Gate,
Musselburgh EH21 7UB.

SOLAR, WIND, WATER POWER

We need an

EXPERIENCED ENGINEER

to join our small team with a degree (or equivalent) preferably in mechanical engineering. Applicants must have a strong interest in renewable energy technology and previous experience in related areas would be an advantage. The job would involve a wide range of work from the use of craft skills such as plumbing, wiring and lathe work to designs of new equipment. Several energy systems at the Centre are being monitored continuously and the routine tasks involved and the analysis of results would form part of the work. The applicant should also be capable of giving short talks to technical audiences on aspects of the work and of representing the Centre in some of its dealings with other organisations and companies. Minimum age 25. Salary up to about £4000 dependent on needs. Apply in writing giving as much information as possible to Dr Robert Todd, Centre for Alternative Technology, Machynlleth, Powys, Wales.

AGRICULTURAL RESEARCH COUNCIL INSTITUTE OF ANIMAL PHYSIOLOGY, BABRAHAM
CAMBRIDGE CB2 4AT

ASSISTANT SCIENTIFIC OFFICER

is required at the Institute of Animal Physiology, Animal Research Station, 307 Huntingdon Road, Cambridge. Work will include assistance in biochemical studies on spermatozoa and sperm enzymes relating to fertilization. Experience in biochemical techniques useful but not essential. Minimum educational qualifications: GCE (O) in Grades A—C or CSE (Grade 1) in four subjects including English language and a scientific subject or maths. Salary in scale £1931 at 17, £2336 at 19, to £3303 a year. Maximum starting salary at age 22 (or over) £2731 a year. Day release for approved Technical College course (chemistry at (O) level necessary). 5 day week. 4 weeks paid holiday and 10½ public holidays a year. Non-contributory superannuation scheme. Applications with full details to the Secretary of the Institute at Babraham quoting Ref. A.R.S.24/NS by the 19 February, 1979.

UNIVERSITY OF GLASGOW

DIRECTOR OF THE INSTITUTE OF SOVIET AND EAST EUROPEAN STUDIES

Applications are invited for the post of Director which will shortly become vacant. The stipend will be within the Professorial range.

Further particulars may be obtained from the Secretary of the University Court (Room 18), University of Glasgow, Glasgow G12 8QQ, with whom applications (15 copies; in the case of overseas applicants, 1 copy), giving the names and addresses of three referees, should be lodged on or before 2 March, 1979.

In reply please quote Ref. No 4357N.

Are you a Massspectrometerperson?

We require within the Analytical Biochemistry Section of our Drug Metabolism Unit an individual with initiative and some experience in mass spectrometry to tend our DuPont 491 GC/MS and attendant PDP8 based data system.

The major work-load involves quantitative analysis of drugs in body fluids by GC/MS using M.I.D. with stable isotopes. Identification of metabolites is also undertaken for biochemists in the Unit.

Applicants should have a good chemistry background equivalent to at least HNC standard, and an interest in electronics and/or computing would be a distinct advantage.

Salary will reflect the experience and qualifications of the successful applicant. If you wish to apply please write to Karen Emery, Personnel Officer, Beecham Pharmaceuticals Research Division, Medicinal Research Centre, The Pinnacles, Harlow, Essex CM19 5AD or telephone our answering service on Harlow (0279) 419373 for an application form, quoting our reference 64/NS

Beecham
Pharmaceuticals

UNIVERSITY OE STRATHCLYDE
Department of
Natural Philosophy

PROFESSOR OF EXPERIMENTAL PHYSICS

Applications are invited from appropriately qualified and experienced candidates for appointment to the newly established Professorship in Experimental Physics which will involve a period of years as Chairman of the Department of Natural Philosophy. Applicants should have experience in one or more areas of Experimental Physics and be capable of directing postgraduate teaching and research.

The post will be remunerated within the Professorial range for universities with USS benefits.

Application forms and further particulars (quoting 5/79) may be obtained from the **Registrar, University of Strathclyde, Royal College Buliding, 204 George Street, Glasgow G1 1XW, with whom applications must be lodged by 28 February, 1979.**

UNIVERSITY OF OXFORD
Department of Engineering Science

INSTRUMENTATION DEVELOPMENT

A research worker is required to join a small but active group with research interests in soil consolidation, through experimental studies both in the laboratory and in the field. Initially, the successful candidate would undertake the design of an electronic system for density measurements with X-rays, followed by the development of further laboratory and marine instrumentation. The appointment would be for three years in the first instance, with a salary in the range £3883-£5604. Please write for further details to the Administrator, Department of Engineering Science, Parks Road, Oxford OX1 3PJ. The closing date for applications is 28 February, 1979.

BIOLOGISTS

. . . to help develop natural history exhibitions

The British Museum (Natural History) is an institution for taxonomic research and has world wide collections of animals, plants and minerals. The Department of Public Services is responsible for the dissemination of information through educational conferences, written publications and exhibitions.

As members of a team within the Department, the successful candidates will work with designers, scriptwriters and educational technologists on the development of new natural history exhibitions. The traditional display is being replaced by a completely new scheme designed to present an integrated view of modern biology. The biologists appointed will take responsibility for the organisation and presentation of subject matter and will maintain a close liaison with designers to specify the content and structure of exhibits.

Candidates, normally aged under 27, should have an honours degree or equivalent in biology, zoology, botany or other closely related discipline. The ability to work to strict deadlines is essential.

The appointments will be for 3 years, although subsequent permanent appointment is a possibility.

Salary in the range £3300–£4880 with starting salary according to qualifications and experience.

For further details and an application form (to be returned by 16 February, 1979) write to Civil Service Commission, Alencon Link, Basingstoke, Hants RG21 1JB, or telephone Basingstoke (0256) 68551 (answering service operates outside office hours). *Please quote ref: S/5052.*

BRITISH MUSEUM (NATURAL HISTORY)

QUEEN ELIZABETH COLLEGE
Kensington
University of London

LECTURESHIP IN FOOD SCIENCE

Applications are invited for the post of Lecturer in Food Science. Applicants will be expected to have an appropriate academic background, preferably with research experience in an area of Food Science. The successful applicant will be required to teach some unit courses in Food Science to different years of the degree course and to undertake research. External contracts will be encouraged. Industrial or other relevant experience would be an advantage and placing on the salary scale will reflect both qualifications and experience. Salary scale £3909-£7754 pa plus London allowance of £450 pa.

Apply to the College Secretary, Queen Elizabeth College, Campden Hill Road, London W8 7AH, from whom further particulars and an application form may be obtained. Closing date: 28 February 1979.

MAKE USE OF YOUR SCIENCE

Your science degree, laboratory background, or 'A' levels could help you become a medical/scientific representative. Many vacancies for trainees exist throughout the UK, with salaries around £4,000 + Car + Benefits. 'Phone or write (no stamp needed), for your copy of our information leaflet to Colin Mackinnon.

01-221 5222

Talentmark
Leaders in Health Care Recruitment
Freepost, London W2 1BR.

SCOTTISH MARINE BIOLOGICAL ASSOCIATION
Dunstaffnage Marine Research Laboratory
near Oban, Argyll

ELECTRONIC ENGINEER

Applications are invited for the post of Scientific Officer/Senior Scientific Officer in the Physics Department. Work will be concerned with the design and construction of hydrographic and biological monitoring systems both in the laboratory and at sea. Qualifications required: Good Honours degree or equivalent with experience in circuit design. Application forms and particulars of salary and conditions of service may be had, on written application, from the Administrative Officer, Dunstaffnage Marine Research Laboratory, PO Box 3, Oban, Argyll PA34 4AD.

TECHNICIAN

required for Department of Microbiology to be responsible for the running of laboratories. ONC or equivalent in Microbiology.

Salary scale £2688–£3060 pa. Ref. 139/C/368.

Application form from

Assistant Secretary, Personnel Office, University of Birmingham, PO Box 363, Birmingham B15 2TT.

ELECTRON MICROPSCOPY

Applications are invited for two newly-established positions in our rapidly expanding Electron Microscopy Unit, within the Department of Pathology. The unit is concerned with ultrastructural toxicological effect of pharmaceuticals, agricultural and industrial chemicals.

ELECTRON MICROTOMIST

The successful applicant will have extensive experience in preparing varied biological material for electron microscopy, and in particular those skills associated with sectioning. Knowledge of cell biology and experience in the maintenance of an electron microscope would be advantageous, but not essential. Applicants should have an HNC/AIMLT, although individuals with other qualifications and appropriate experience are invited to apply. The position offers the opportunity of acquiring all the skills associated with toxicological electron microscopy, including use of electron microscope, ultrastructural appraisal and analysis in the expanding field of toxicological evaluation. Reference: AKS/1A

TECHNICIAN

The successful applicant will assist in the preparation of specimens for toxicological electron microscopy, scientific photography and in the day-to-day running of the Unit. Applicants should have a sound education including 'A' level Biology. Laboratory experience would be an advantage, but is not essential. Reference: AKS/2A

FOR THE ABOVE POSITIONS THE COMPANY OFFERS GENEROUS SALARIES, PENSION SCHEME, SUBSIDISED STAFF RESTAURANT AND 4 WEEKS ANNUAL HOLIDAY. PLEASE WRITE OR TELEPHONE QUOTING THE APPROPRIATE REFERENCE TO:

**LIFE
SCIENCE
RESEARCH
Stock, Essex. CM4 9PE.
Telephone: Stock (0277) 840101**

LSR

Assistant to Client Relations Manager

IRI is a leading contract research company in the biological and chemical fields, undertaking varied projects for a wide range of clients, including pharmaceutical and chemical manufacturers and government departments, both in the UK and abroad. The Client Relations Manager is responsible for liaison between the Company's scientists and existing and potential clients, on the requirements and progress of current and future contracts.

Due to continuous expansion, an Assistant is now required to undertake some of these activities. Candidates will be graduates with some experience in toxicology or a closely related field, free to travel abroad and with a good knowledge of at least one European language. The ability to communicate effectively and an outgoing personality are essential. Preferred age range 25-35 years.

Application forms, quoting ref. 6104 are available from

IRI

**Miss J. M. Dunbar,
Inveresk Research
International,
Inveresk Gate,
Musselburgh EH21 7UB.**

TECHNICIAN (GRADE 3)

required in Plant Science Laboratories, University of Reading, for Electron Microscope Unit dealing with botanical material. Experience in specimen preparation for and operation of SEMs and TEMs essential. TST Diploma in Electron Microscopy preferred but applicants with ONC or 2 science 'A' levels considered. Salary in scale £2688-£3060 pa (under review). Apply with names of two referees and full details, quoting Ref. T.S. 77A, to Assistant Bursar (Personnel), University of Reading, Whiteknights, Reading RG6 2AH.

ELECTRICAL ENGINEERING TECHNICIAN

required to service clinical chemistry instruments, and to assist in the construction of prototype apparatus. Applicants should preferably have experience in this field and ONC or City & Guilds certificate in Electrical Engineering or Applied Physics. Salary within range £3261-£4680+£354 pa London allowance. Apply, The Secretary, St Mary's Hospital Medical School, Paddington W2 1PG, quoting Ref EE/LN.

TECHNICIAN/ RESEARCH OFFICER

required to assist in our Biological Safety Laboratory and the Cell Culture Laboratory. Microbiological training is essential. HNC or Degree required. Salary range £3600-£5200 inc. L.W., pension scheme. For further information and application form, telephone **Miss S. M. Hurley, Imperial Cancer Research Fund, Lincoln's Inn Fields, WC2 on 242 0200 ext 305.**

MANAGER, COAL RESEARCH

The Alberta Research Council, a provincial crown corporation, has an opening at a senior level for a manager of its various coal research activities. The Council has a well-established group of scientists and engineers working on the chemistry, conversion and carbonization of coal, and on related problems, and is looking forward to significant expansion in programs and facilities in the near future.

We are seeking someone with experience in research administration and also with extensive knowledge and experience of coal.

The salary is open and will depend on qualifications and experience.

Application and requests for further information should be sent to:

**Dr H. W. Habgood,
Chief, Physical Sciences Branch,
Alberta Research Council,
11315—87th Avenue,
Edmonton, Alberta, Canada T6G 2C2**

TECHNICIAN (GRADE 4)

required in Department of Agriculture and Horticulture, University of Reading, to work on projects, supported by the International Board for Plant Genetic Resources, concerned with the long-term storage of seeds for genetic conservation, under the direction of Professor E. H. Roberts. The work involves preparing seeds for low-temperature storage, monitoring deterioration under storage using germination tests and various other physiological techniques. HNC or equivalent qualification desirable. One year appointment in first instance with possibility of renewal. Salary in scale £2955-£3402 pa (under review). Apply with full details of qualifications and experience, names of 2 referees, and earliest date of starting, quoting Ref. T.S. 03A, to Assistant Bursar (Personnel), University of Reading, Whiteknights, Reading, Berks RG6 2AH.

UNIVERSITY OF SOUTHAMPTON

Institute of Sound and Vibration Research

EXPERIMENTAL OFFICER

required by Industrial and Machinery Noise Group, to undertake design and testing of machinery components. The applicants should be graduate engineers with practical workshop and drawing office experience.

Salary scale £3384-£5367 per annum (under review) plus USS benefits.

Applications, giving a brief curriculum vitae and the names of three referees, should be sent to D. A. S. Copland, The University, Southampton SO9 5NH, quoting reference 184/A/NSc.

Technicians

The Department of Applied Biology & Food Science invites applications for the following positions from suitably qualified and experienced persons.

GRADE 4 Microbiology Section

Responsibilities include preparation of materials for undergraduate and postgraduate requirements, maintenance of culture collection, maintenance of cleanliness of microscopes, section cutting using microtomes, maintaining laboratories in a constant state of cleanliness and tidiness, disposal of infected waste materials and limited supervision and guidance of other staff.

GRADE 2B Food Analysis Laboratory

Responsibilities include preparation of materials and reagents under supervision for practical classes in Food Science, assisting with cleaning and maintenance of apparatus and equipment, assisting in maintaining laboratories in a constant state of cleanliness and tidiness. Knowledge of chemical analytical techniques required.

GRADE 2B Biochemistry Laboratory

Responsibilities are the same as those above for Food Analysis laboratory, except that a knowledge of biochemical techniques is required.

Qualifications & Experience

Grade 4. OND: ONC: Ordinary Certificate CGLI/IST or equivalent. 7 to 9 years experience.

Grade 2B. Qualifications as for Grade 4 plus 3 to 5 years experience.

Salary Scales (including London Allowance)

Grade 4 £3441-£3891. Grade 2B £2994-£3363.

Polytechnic of the South Bank

Application form from Staffing Office,
Polytechnic of the South Bank,
Borough Road, London SE1 0AA
(01-928 8989 Ext: 2023).

UNIVERSITY OF DURHAM

Department of Applied Physics and Electronics

Applications are invited for the post of

LECTURER

in the Department of Applied Physics and Electronics tenable from 1 October, 1979. Candidates should have research and/or industrial experience in the general area of microelectronics. Preference will be given to those with research interests in silicon devices and/or technology.

Salary on the scale £3883 to £7754 (under review), plus superannuation benefits, according to age and experience.

Applications (three copies) naming three referees should be submitted to the Registrar and Secretary, Science Laboratories, South Road, Durham DH1 3LE, not later than Monday, 26 February, 1979, from whom further particulars may be obtained.

EASTBOURNE COLLEGE

Independent School

Two thirds boarding. 500 boys, 44 VIth Form girls.

Young Biologist

wanted in September to join a strong department. Teaching throughout 13-18 age range likely. Accommodation available. On salary scale.

Willingness to assist with activities outside the classroom essential. Write with curriculum vitae and the names of two referees to: **The Headmaster, Eastbourne College, Eastbourne, Sussex NB21 4JX.**

RESEARCH CHEMIST

PHARMACEUTICAL INDUSTRY

Pfizer Central Research is part of a leading international group engaged in the research, development, manufacture and marketing of a wide range of human medicinal and animal health products.

We have a vacancy for a chemist to work in our Agricultural Chemistry Department. Preferred male or female applicants will have:–

- Qualifications at HNC, GRIC, or B.Sc. level.
- Several years experience in synthetic organic chemistry, preferably in the pharmaceutical industry.
- Proven ability as an experimentalist.
- The ability to work with minimal supervision.

In return we offer:–

- A competitive starting salary within an incremental pay system.
- Varied synthetic work supported by first class analytical and library facilities.
  - Modern laboratories within easy reach of pleasant seaside resorts, the Kentish countryside and Continental Europe.
  - Flexible working hours.
  - Participation in Bonus, Salary Continuance, Pension and Death Benefit schemes.
  - A flourishing sports and social club.

Pfizer

If you are interested in this opportunity write or telephone for an application form to:– Graham Marshall, Personnel Officer, Pfizer Central Research, Sandwich, Kent. Tel: (03046) 3511

THE LONDON HOSPITAL MEDICAL COLLEGE

(University of London)

Virology Department

MEDICAL LABORATORY SCIENTIFIC OFFICER

Professor L. H. Collier requires a junior or middle grade Medical Laboratory Scientific Officer as his personal assistant in an interesting research project involving virological and immunological techniques. Practical experience in one or both of these disciplines will be a considerable advantage. Day release facilities available.

Salary based on Whitley Council scales for Medical Laboratory Scientific Officers.

Enquiries to Professor L. H. Collier, telephone 01-247 5454 ext. 164.

Applications to The Secretary, The London Hospital Medical College, Turner Street, London E1 2AD, quoting reference V/1/79.

ROYAL FREE HOSPITAL SCHOOL OF MEDICINE

(University of London)

Department of Biochemistry and Chemistry

JUNIOR TECHNICIAN

Junior Technician required to join membrane research group. Salary on Whitley Council scales according to age and experience. Further particulars and application forms available from the School Secretary, RFHSM, 8 Hunter Street, London WC1N 1BP, or telephone 01-837 5385 ext. 54. Closing date 23 February, 1979.

TECHNICIAN (GRADE 3)

required in Plant Science Laboratories, University of Reading, for Ecology Section. Varied duties including assistance with field crop experiments, maintenance of growth rooms, running computer programs, and plant growth analysis. Driving licence an advantage. Qualifications required—ONC or SLT Part 1 or 2 'A' levels, plus laboratory experience. Salary in scale £2688-£3060 pa (under review). Apply with full details and names of 2 referees, quoting Ref. T.S. 78A, to Assistant Bursar (Personnel), University of Reading, Whiteknights, Reading RG6 2AH.

ST GEORGE'S HOSPITAL MEDICAL SCHOOL

(University of London)

TECHNICIAN GRADE 3

required to assist with laboratory research on respiratory physiology and disease, including the use of experimental animals. May also be required to assist with practical classes for medical students. Emoluments £2963-£3335 (under review). Four weeks annual holidays plus 13 other days. Further details and application forms available from the Establishment Officer, St George's Hospital Medical School, Cranmer Terrace, London SW17 0RE.

ST THOMAS'S HOSPITAL MEDICAL SCHOOL

A RESEARCH ASSISTANT

is required in the Department of Gynaecology (Biochemistry Laboratory) for a new project on hormonal mechanisms in cyclical migraine. An Honours Degree in Biochem. (or equivalent) is required and experience of radioimmunoassay will be an advantage though not essential. Starting salary £3855 inclusive. Information from, and applications giving full details to, Dr M. G. Brush, St Thomas's Medical School, London SE1 7EH.

Copyrighted material

AREA MEDICAL PHYSICS DEPARTMENT THE LEICESTER ROYAL INFIRMARY

This department, which is undergoing a planned expansion programme, provides Medical Physics services for hospitals of the Leicestershire Area Health Authority, and is based at The Leicester Royal Infirmary which is the main hospital associated with the Medical School at the University of Leicester.

Two vacancies have arisen in the department which has close links with both the new Medical School and with the University Physics Department.

PHYSIOLOGICAL MEASUREMENT SECTION

Physicist Senior or Basic Grade (I) Ref 1/79

The person appointed to this post will be expected to participate both in the routine work, and the research commitments of the section. Particular interests include haemodynamics, urodynamics and the application of mini-computers and micro-processors to the interpretation of physiological data. The successful applicant should have a good knowledge of modern electronics, and preferably of physiological measurement techniques.

Physicist Basic Grade (I) Ref 2/79

Applications are invited for the post of basic grade physicist in the Leicestershire Area Medical Physics Department. The successful candidate will participate in all aspects of the work of the department including Nuclear Medicine, Radiotherapy, Electronics and Instrumentation. The post would be suitable for recent graduates. Candidates should possess a good honours degree in Physics/Electronic Engineering.

Salary Basic Grade — £3486–£4899
Senior Grade — £5457–£6837

For further information please telephone **Mr J. T. Griffiths on Leicester 541414 ext 468.**

Leicestershire Health Service

LEICESTERSHIRE AREA HEALTH AUTHORITY (TEACHING)

CORNWALL
Social Services Department

Joint care planning officer
£4773-£5073 p.a. (AP.5)

A Joint Care Planning Officer is to be appointed for three years only, under Joint Financing arrangements with the Area Health Authority. The person appointed will undertake research into the needs of elderly and younger physically handicapped in Cornwall, and draw up recommendations for future resource provision, using the Balance of Care Model developed by the Institute of Biometry and Community Medicine (University of Exeter). He or she will be appointed to the Social Services Department and will work closely with staff of the Area Health Authority and with IBCM.

Previous experience in planning or research, preferably in a Health or Social Services Authority, would be relevant; education to degree standard would be appropriate, possibly with some training in statistics or operational research. Essential, however, are numeracy, and the abilities to research, report, liaise and communicate effectively with a diversity of people.

For informal discussion, please contact Miss K. M. Lee, Assistant Director, Truro 74282, Extension 323.

Further details and an application form may be obtained from the Director of Social Services, County Hall, Station Road, Truro.

METALS TECHNOLOGIST

Southampton £4150

Pirelli General manufactures a wide range of power and telecommunication cables at their 3 factories in the Southampton area, and are part of the International Pirelli Organisation.

This position is in the Metallurgy Section of the Central Materials Laboratory based at our Engineering Department at Eastleigh.

The work will be mainly concerned with investigations into material quality and the provision of technological assistance in the manufacture of copper and aluminium wire and strip by rolling, wire-drawing, annealing and various ancillary operations. Much of the work can be carried out in the Company's modern laboratories and the manufacturing Department is currently being completely reorganised and modernised. The job presents a challenge to someone with a suitable academic background and a strongly developed practical capability.

Applicants should be between 21 and 30 years of age with ONC/OND—HNC/HND in Science, Metallurgy or Mechanical Engineering but preference will be given to candidates with previous technological experience in this or a closely related field. Specialised product training will be given. Salary c £4150 (including supplements and bonus).

Assistance will be given towards the cost of re-location expenses where appropriate.

Please write or telephone for an application form to:

Mr C. L. Baldam,
Staff Officer,
Pirelli General Cable Works Ltd,
PO Box 4, Western Esplanade,
Southampton.
Telephone Southampton 20381 Extension 150

PIRELLI GENERAL

MRC CLINICAL RESEARCH CENTRE
(Northwick Park Hospital)
Watford Road, Harrow, Middx HA1 3UJ

Technician

required for the section of electron microscopy. The appointee will play a dual role, to prepare specimens for scanning and transmission EM for Dr Dourmaskhin, and to carry out an EM service under the latter's supervision. Experience in biological EM is desirable, but not essential.

Applicants should hold HNC or equivalent. Salary within the range £3615 to £5034 PA. incl. LW. Application forms from Mrs J. Tucker-Bull. Please quote ref. 112/2/4126. Interviews will be held in February.

MRC CLINICAL RESEARCH CENTRE
(Northwick Park Hospital)
Watford Road, Harrow, Middx HA1 3UJ

Technician

is required for biochemical work in the division of perinatal medicine. The work will include enzyme assay on tissues and the use of HPLC for analysis. Previous experience in the relevant analytical techniques would be an advantage.

Applicants should hold an HNC or science degree. Salary within the range £3615 to £5034 p.a. incl. LW. Application form and further details from Mrs J. Tucker-Bull. Please quote ref. no. 133/2/4325. Closing date 22 February, 1979.

UNIVERSITY MUSEUM OXFORD

CURATORIAL ASSISTANT (MINERALOGY)

It is proposed to appoint for a period of three years an Assistant to the Curator of the Mineralogical Collections. Salary will be on academic-related scale £3384-£4466 per annum (under review), according to qualifications and experience, with membership of USS. The work will include assistance with the design and execution of exhibits, the identification of minerals, routine accession and curation of minerals.

The successful candidate is expected to hold a degree in geology and to have some skills in mineral recognition and/or museum display work.

Applications, including curriculum vitae and the names and addresses of two referees, should be received not later than 20 February, 1979, by Dr F. B. Atkins, University Museum, Parks Road, Oxford OX1 3PW, from whom further particulars may be obtained.

UNIVERSITY OF HULL

Department of Applied Physics

RESEARCH ASSISTANTSHIP —NON-DESTRUCTIVE TESTING

Applications are invited for a research assistantship tenable for a period of up to two years in the first instance with the possibility of renewal. The research assistant will be involved in the study of magnetic particle inspection testing and ultrasonic testing of a wide variety of industrial components, in collaboration with the Health and Safety Executive, Nuclear Inspectorate.

Salary scale: £3384-£4882 (under review) together with USS benefits.

Applications, which should include the names of two referees, should be sent as soon as possible to Dr S. B. Palmer, Department of Applied Physics, The University of Hull, Hull HU6 7RX, from whom further particulars may be obtained.

ANALYST

A qualified analyst is required to take charge of analytical services at a new treatment plant, situated in the St. Albans area, designed to handle a variety of liquid industrial waste.

The analytical requirements will be mainly inorganic and the successful candidate will be expected to have practical experience of atomic absorption and wet chemical techniques. In addition, it will be necessary to monitor the performance and efficiency of a biological treatment plant, through which all treated effluent is passed prior to discharge.

Candidates with several years experience should submit full details, in writing, of their qualifications and experience to date, to:—

C. de Grey (Technical Director), Contract Gully Cleansing Ltd., Brownfields, Welwyn Garden City, Herts. Tel. Welwyn Garden 20163.

MEDICAL RESEARCH COUNCIL PNEUMOCONIOSIS UNIT

Llandough Hospital, Penarth, South Glam. CF6 1XW

Young graduate

or equivalent required to work on the development of new physical methods for quantifying asbestos fibres in human tissues and in the air. Some experience of instrumentation would be helpful.

Starting salary dependent on age and experience but probably within the range £3261 to £3582.

Application forms obtainable from the **Assistant Administrative Officer** at the above address.

MEDICAL RESEARCH COUNCIL

Radiobiology Unit, Harwell Oxon

A vacancy has arisen for a

RESEARCH OFFICER/ TECHNICIAN

to work on studies of damage to DNA by ionising radiation. Experience in either microbiology or electronmicroscopy of macromolecules would be an advantage. Enthusiasm and adaptability are essential.

Qualifications for Technician are HNC or equivalent while a Research Officer would have at least two years' relevant experience in addition. Salary scales are £3261-£4680 for Technician and £3582-£4902 for Research Officer. Assisted transport and modern hostel accommodation for single people are available. Applications, giving full personal details including the names of two referees, should be addressed to The Administrator, MRC Radiobiology Unit, Harwell Didcot, Oxon OX11 0RD. Ref KB2.

BRISTOL POLYTECHNIC

Department of Science

TECHNICIAN—PHYSICAL SCIENCES

Ref T3345/132

The successful applicant will assist with the servicing of the Physics, Physical Chemistry and Blood Serology Laboratories in the Physical Sciences group.

Applicants should possess an O.N.C. Intermediate City & Guilds or equivalent qualification in an appropriate subject. Previous laboratory experience is essential.

Salary scale: T2—£2967—£3339 + £312 supplement. Additions of £72 or £42 for appropriate National Certificate or City & Guilds qualifications will be payable where appropriate.

Further details and application forms, to be returned by the 19th February 1979, from the **Personnel Office, Bristol Polytechnic, Coldharbour Lane, Frenchay, Bristol BS16 1QY.**

Please quote Post Reference No. T3345/132 in all communications.

UNIVERSITY OF EDINBURGH

DEPARTMENT OF STATISTICS

Applications are invited for a newly established Lectureship in Statistics. Duties will include teaching, research, and consultation; more detailed information can be obtained from the address below. The starting date will be 1 October, 1979, or earlier if convenient. Salary on scale £3883—7754 per annum, with superannuation and initial placement according to qualifications and experience.

Please apply by letter, including names of three referees, to:

The Secretary to the University,
University of Edinburgh,
Old College,
South Bridge,
Edinburgh EH8 9YL

not later than 23 March, 1979. Please quote reference 1004.

LECTURES, MEETINGS AND COURSES

WEIZMANN INSTITUTE OF SCIENCE REHOVOT ISRAEL INTERNATIONAL SUMMER SCHOOL

18 July—20 Aug, 1979

Applications are invited from outstanding young scientists (of any donomination) between 17 & 19 years (recommended by their Headmaster/Headmistress or Head of their Science Dept.) who also possess an aptitude for mixing with young people from other countries. Programme includes work in laboratories besides lectures and field studies and a tour of Israel.

Further particulars and application forms from **Weizmann Institute Foundation, 11 Rodmarton Street, LONDON W1H 3FW.** Completed applications to be received by 5 March, 1979.

CHELSEA COLLEGE (University of London)

Basic Medical Sciences Group

The following courses, leading to MSc by examination, will commence in October, 1979.

MSc General Biochemistry

2 academic years part-time (2pm–9pm, 1 day/week). Candidates should be honours graduates in Chemistry, Pharmacy or a Biological Science; or hold a degree in Medicine or Veterinary Medicine.

MSc Biophysics and Bioengineering*

2 academic years full-time. Candidates should be honours graduates in Science, Medicine or Engineering or hold an approved equivalent qualification.

MSc Immunology

2 academic years part-time (1 day/week). Candidates should be honours graduates in a Biological Science or Medical Science.

MSc Pharmacology*

1 academic year full-time. Candidates should be honours graduates in Science, Pharmacy or Medicine.

* These courses have been accepted by the MRC or SRC for the tenure of Advanced Course Studentships.

For further information and application forms write to:

Group Secretary, Basic Medical Sciences Group,
Cheslea College, Manresa Road, London SW3 6LX

Roehampton Institute

Digby Stuart Froebel Southlands Whitelands

COURSES IN SCIENCES SUBJECTS

Biology, Chemistry, Social Biology

Combined degree courses (University of London) leading to careers in industry, science teaching and related areas.

BACHELOR OF HUMANITIES (BH). One or two Sciences may be combined with subjects such as Business Studies, Education, History, Home Economics, Religious Studies.

BACHELOR OF EDUCATION (BEd). A professional degree in Educational Studies and one or two Science subjects.

BACHELOR OF SCIENCE (BSc) in Social Biology and Psychology.

POSTGRADUATE CERTIFICATE IN EDUCATION. A one year course of teacher training for science graduates.

Further information and advice from:

The Academic Registrar
Roehampton Institute of Higher Education
Roehampton Lane SW15 5PJ

INSTITUTES OF PSYCHIATRY, NEUROLOGY AND OPHTHALMOLOGY

(British Postgraduate Medical Federation, University of London)

POSTGRADUATE COURSE IN NEUROCHEMISTRY

This is a one-year course leading to the degree of MSc in Neurochemistry. It offers graduates in science and medicine training in basic and applied neurochemistry. The course consists of lectures, seminars and laboratory work and, in the second and third terms, research on a neurochemical topic.

Applicants should have an honours degree in Biochemistry or a Biological subject with some Biochemical component, or be Medically qualified. The course is recognised by the Medical Research Council as an Advanced Course for the award of Training Scholarships to suitably qualified applicants.

Application for the Academic year October 1979-July 1980 should be addressed to the Secretary, Course in Neurochemistry, Department of Biochemistry, Institute of Psychiatry, De Crespigny Park, Denmark Hill, London SE5 8AF, England.

STRAW DECAY SYMPOSIUM WORKSHOP ON TECHNIQUES TO MEASURE DECAY

HATFIELD POLYTECHNIC APRIL 10-11 1979

Topics: Effects of straw residues on crop establishment, toxin formation, pathogens, fauna.

Decay of straw in or on soil, in Summer, treatments for increased digestibility, biocide effects, microbiological and biochemical aspects.

Contact: Grossbard, Hatfield Polytechnic, Bayfordbury House, Hertford. Tel.: Hertford 53067.

UNIVERSITY OF ESSEX

Department of Biology

MSc COURSE: GENE TECHNOLOGY IN MICROORGANISMS

Applications are invited for the above 1 year course for October 1979. A limited number of studentships may be available. The course is designed to acquaint the student with the techniques of classical microbial genetics, and in vitro recombinant DNA techniques. Enquiries should be addressed to The Chairman, University of Essex, Department of Biology, Wivenhoe Park, Colchester CO4 3SQ.

LOUGHBOROUGH UNIVERSITY OF TECHNOLOGY

MSc Polymer Technology

Enrolments are invited for a 12 month course, commencing October 1979, leading to the degree of MSc by examination. The course is designed to give a broad understanding of the science and technology associated with the rubber and plastics industries. An important part of the course is a five month project carried out in close collaboration with industry.

Applicants should possess or expect to obtain an honours degree, or equivalent professional qualification in science, engineering or technology. The Science Research Council has in previous years accepted the MSc course in Polymer Technology as suitable for the tenure of its advanced course studentships.

Further information about this course and research opportunities can be obtained from Professor A. W. Birley, Institute of Polymer Technology, University of Technology.

Loughborough *Leicestershire*

BRITISH COUNCIL COURSE THE LYMPHOCYTE

2-14 DECEMBER, 1979

The aim of this course is to familiarise participants with the latest advances in Britain in the immunology of the lymphocyte and to update their knowledge of current concepts of the role of the lymphocyte in adaptive immunological processes. Lectures, discussion periods, demonstrations and some practical work will highlight central developments such as the role of the major histocompatibility complex and recent technological advances.

The Directors of Studies will be Professor I. M. Roitt and Dr P. M. Lydyard of the Middlesex Hospital Medical School, London, where the course will be based.

Members of this course will be postgraduates, mainly working outside Britain, who are laboratory investigators or clinicians with 2-3 years' experience in immunology or allied fields.

Fee: including demi pension: £475.

Application forms, which should be in London by 1 July, 1979, are available from your local British Council Representative or from The Director, Courses Department, The British Council, 65 Davies Street, London W1Y 2AA, Great Britain.

UNIVERSITY OF CAMBRIDGE

Department of Metallurgy and Materials Science

ONE YEAR M PHIL COURSE IN MATERIALS TECHNOLOGY

The University has introduced a new degree the Master of Philosophy in Materials Technology. The course aims to give training in the Materials research techniques and technology most relevant to the needs of development laboratories and industrial concerns.

Each student will undergo training in collaboration with a particular industrial firm. The lecture programme will be tailored to individual needs and the student will undertake a research project chosen for its direct relevance to the collaborating concern. Applications are invited from persons who possess or expect to get a good honours degree in subjects such as Metallurgy, Materials Science, Engineering Physics and Chemistry.

The course has been accepted as qualifying for the award of SRC Advanced course Studentship. Applications and enquiries should be sent to the Course Convenor, **Dr B. Ralph, Department of Metallurgy and Materials Science, University of Cambridge, Pembroke Street, Cambridge.**

Industrially Relevant MSc and PhD Programmes

Scientists, Technologists, and Engineers, Cranfield MSc and PhD programmes are designed to fit **you** for responsible positions in industry.

Intensive one year MSc's by project and coursework are offered in:

METALS ENGINEERING
POLYMER ENGINEERING
OFFSHORE ENGINEERING
WELDING TECHNOLOGY

to applicants with a good Honours degree (or equivalent) or with appropriate industrial experience. A preliminary foundation year is undertaken by those with a Pass degree, HND or equivalent.

Substantial awards are available to suitably experienced, qualified people. For details of courses, housing, grants, etc. contact:

Mrs J. Grey (ref NS/1),
Department of Materials,
Cranfield Institute of
Technology,
Bedford MK43 0AL.

Tel.: 0234-750111 ext. 324.

CIT
CRANFIELD INSTITUTE OF TECHNOLOGY
ADVANCED TEACHING - APPLIED RESEARCH

INTERNATIONAL SYMPOSIUM

Food and Health—Science and Technology

8–12 April, 1979

This tenth annual international symposium will deal with the control of national food quality, chemical, metabolic and microbiological aspects, health foods, additives and contaminants, healthy eating, special processing and packaging aspects, food and the brain and infant nutrition. Speakers will include experts from the UK, USA, Holland, Germany, Italy, Switzerland and Poland. The keynote lecture, "Food and Health from Conception to Extreme Old Age" will be given by Dr Elsie M. Widdowson.

Programmes containing application forms are available from **The Secretary, National College of Food Technology (University of Reading), St George's Avenue, Weybridge, Surrey.**

UNIVERSITY OF OXFORD MSc IN THE SCIENCE AND APPLICATIONS OF ELECTRIC PLASMAS

A course of one year's duration leading to the MSc in the Science and Applications of Electric Plasmas, is held annually. It is concerned with Ionisation Phenomena in Gases, Fundamental Properties of Plasmas and Practical Applications; it includes experimental work part of which is done at the Culham Laboratory of the UKAEA and the Rutherford Laboratory of the SRC. The teaching is carried out by the staff of the Department of Engineering Science and by invited scientists from government laboratories and industry.

Applications are invited for the course beginning in October 1979 from candidates who have a good honours degree in Engineering, Physics or Mathematics (or comparable qualifications), or expect to qualify in 1979.

The course is a valuable preparation for DPhil candidates who normally require an additional two years of research.

Applications and enquiries should be sent to: The Secretary, Electric Plasma Course, Engineering Science Laboratory, Parks Road, Oxford OX1 3PJ.

CITY OF LONDON POLYTECHNIC

British Trust for Conservation Volunteers
Herts and Middlesex Trust for Nature Conservation

Announce

A one-day conference and workshop which will review common problems facing teachers and volunteer leaders wishing to promote conservation—

on Thursday 22 March, 1979

Fee: £7 including lunch

For further details please apply to:

The Short Course Unit,
City of London Polytechnic,
84, Moorgate,
London EC2M 6SQ.
Telephone: 01-283 1030 ext 324

ELECTRICAL DISCHARGES IN IGNITION AND COMBUSTION

A post experience course will be held at Imperial College from 1 to 3 May, 1979. Details from Dr M. D. Carabine, Chem. Eng. and Chem. Tech., Imperial College, London SW7 2BY. Tel: 01-589 5111, Ext 1906.

STUDENTSHIPS

THE OPEN UNIVERSITY

Research Studentships in Electronics

The Open University invites applications for full-time Research Studentships in Electronics and Communications. Departmental research interests are in the following areas: New Communication Systems; Digital Communications; Microprocessor Applications; Computer Architecture, Applications of Ultrasonics.

Successful applicants will read for a higher degree of the Open University. Applicants should normally have (or expect to gain in July 1979) a good honours degree. The conditions applying to the awards are similar to those for studentships of the Research Councils. Further particulars and application forms may be obtained from the Higher Degrees Office, The Open University, PO Box 49, Walton Hall, Milton Keynes MK7 6AO. Please quote reference NS/E. The closing date for receipt of applications: 22 February

UNIVERSITY OF SURREY

Institute for Educational Technology

RESEARCH STUDENTSHIP

Applications are invited for a Research Studentship in this small research institute, in connection with a programme of Research aimed at improving Teaching and Learning in Higher Education.

Candidates should have a good honours degree in a science or social science subject, and while a deep interest in education is essential, experience, although desirable, is not. At present such Studentships are of value £1610 per annum, initially for two years, and may be increased through dependants' allowances, postgraduate experience allowance and older students' allowance. Students are usually permitted to earn an additional £304. The successful candidate will be expected to register for MPhil or PhD.

Applications by 2 March to Professor L. R. B. Elton, Institute for Educational Technology, University of Surrey, Guildford, Surrey, from whom further particulars and application forms can be obtained.

AGRICULTURAL RESEARCH GROUP

STUDENTSHIP

Applications are invited for an ARC postgraduate studentship tenable at the Meat Research Institute for research into the viscoelastic properties of semi-solid foodstuffs

The work will involve a study of the transmission of mechanical pulses through foods and computer analysis of transient stresses generated with an Instron materials tester.

The project is expected to form the basis for a Ph D. thesis in the University of Bristol and the appointment will commence in October 1979

Candidates should possess a First or Upper Second Class degree in Physics or a related subject

Further particulars of the award and allowances together with Application Forms may be obtained from the **Personnel Officer, Agricultural Research Council, Meat Research Institute, Langford, Bristol BS18 7DY.**

PLANT BREEDING INSTITUTE

Maris Lane, Trumpington
Cambridge CB2 2LQ

Cytogenetics/Physiology Departments

POSTGRADUATE STUDENTSHIP

Applications are invited for an Agricultural Research Council postgraduate studentship leading to a PhD in the University of Cambridge commencing October 1979, to work on the genetics and biochemistry of protein components relating to bread quality in wheat. The student required should hold a first or upper second class honours degree in a biological science in which genetics and biochemistry feature strongly.

Remuneration will be in accordance with the Agricultural Research Council Regulations Governing Postgraduate Awards.

Applications together with a curriculum vitae and the names and addresses of three referees should be sent to the Assistant Secretary (Establishment), quoting reference CYT/48, as soon as possible.

UNIVERSITY OF BRISTOL

LONG ASHTON RESEARCH STATION AGRICULTURAL RESEARCH COUNCIL STUDENTSHIP

A studentship will be offered to an honours graduate (first or upper second class) in appropriate science subjects for research on one of the following topics:—

1. Biosynthesis and function of amine conjugates in higher plants.
2. Role of the cuticle in foliar penetration.
3. Cytology and genetics of insensitivity of fungus to fungicides.

Candidates should normally be under 27 years of age on 1 October, 1979 and graduates of a British Commonwealth University, being British subjects normally resident in the United Kingdom.

The successful applicant will be expected to register for a higher degree in the University of Bristol.

Application forms and further particulars can be obtained from:

The Secretary, Long Ashton Research Station, Long Ashton, Bristol, BS18 9AF. The closing date for receipt of completed application forms is 10 March, 1979.

NATIONAL VEGETABLE RESEARCH STATION

ARC RESEARCH STUDENTSHIP

Applications are invited for an Agricultural Research Council postgraduate Studentship for research on the mode of action of systemic fungicides active against Bremia lactucae (lettuce downy mildew) and variation for sensitivity in the fungus to these chemicals. The work will involve laboratory, glasshouse and field studies.

The studentship will be tenable from 1 October, 1979, for up to three years at the NVRS with a view to reading for the degree of PhD at Birmingham University. Candidates should hold or expect to obtain in 1979 a first or upper second class Honours degree in Plant Science with particular emphasis on at least one of the following disciplines: plant pathology, plant biochemistry, plant protection and genetics.

Further particulars and an application form (to be returned by 20 February, 1979) from the Secretary, National Vegetable Research Station, Wellesbourne, Warwick CV35 9EF.

GRASSLAND RESEARCH INSTITUTE
HURLEY, MAIDENHEAD, BERKSHIRE

POST GRADUATE STUDENTSHIP

Applications are invited for the award of a post-graduate studentship funded by the Agricultural Research Council and tenable at the Grassland Research Institute for a period of three years commencing on 1 October, 1979.

The Grassland Research Institute is an Associated Institution of the University of Reading, where the successful applicant will be registered for a higher degree.

There is a choice of projects and candidates should indicate clearly for which project they are applying.

Project 1 To identify the important factors influencing the economic assessment of dairy systems, including the effects of climate, soil and management. The study will involve the construction of a model to determine the response of the system to these factors with a view to improving output.

Candidates should have or expect to obtain a first or upper second class honours degree in a quantitative subject and have an interest in agriculture.

Project 2 To investigate the effects of early season management and water availability on the nitrogen uptake and seasonal pattern of grass growth. The investigation will be field based and will include studies of tillering, herbage growth, nitrogen uptake and soil water.

Candidates should have or expect to obtain a first or upper second class honours degree in Agricultural Botany or Plant Science.

The studentship comprises a tax-free maintenance allowance of £1610 per annum plus compulsory fees and travelling expenses.

Applications by 28 February, 1979 to the Secretary from whom further details may be obtained.

Strathclyde Regional Council—Department of Education

GLASGOW COLLEGE OF TECHNOLOGY

Department of Biological Sciences

SRC Studentship in Biochemistry

or related subject areas to work on the "sodium pump" in essential hypertension. A first or upper second class honours degree is a prerequisite for the award. The post has to be filled by 30 April, 1979. Write or phone for further particulars to Dr T. Duffy, Department of Biological Sciences, Glasgow College of Technology, Cowcaddens Road, Glasgow G4 0BA. Telephone 041-332 7090, ext 283 or 340 not later than 19 February, 1979.

E. MILLER Director of Education

AGRICULTURAL RESEARCH COUNCIL

STUDENTSHIP

Applications are invited for a studentship to work in the Protein Section of the Meat Research Institute.

The project is to investigate the turnover and remodelling of the connective tissues in relation to growth and development.

This will consist of radioactive incorporation studies together with autoradiography, the chemical analysis of connective tissue components and an examination of the cellular mechanisms for resorption of tissue.

The project is expected to form the basis for a PhD thesis in the University of Bristol and the appointment will commence in October, 1979.

Candidates should possess a First or Upper Second Class degree in Biochemistry. Further particulars of the award and allowances together with application Forms may be obtained from the **Personnel Officer, Agricultural Research Council, Meat Research Institute, Langford, Bristol BS18 7DY.**

UNIVERSITY OF NEWCASTLE UPON TYNE

Department of Atomic Physics

SRC CASE STUDENTSHIP

Applications are invited from those who have, or hope to obtain in 1979, a good honours degree in Physics or a related subject for a 3-year CASE studentship to undertake experimental spectroscopy in the vacuum ultra violet part of the electromagnetic spectrum. The project will involve the development and production of light sources suitable for high precision spectroscopy and will be carried out in collaboration with The Quantum Metrology Division of the National Physical Laboratory at Teddington where it is intended that the student will spend about a year while working towards the degree of PhD. For further details,w rite to Dr W. H. King., School of Physics, University of Newcastle upon Tyne NE1 7RU.

MEDICAL RESEARCH COUNCIL

National Institute for Medical Research

POSTGRADUATE STUDENTSHIPS

The National Institute for Medical Research has positions for postgraduate students to study towards the degree of PhD. The fields of interest are broadly those covered by the following divisions and laboratories of the Institute, namely: Bacterial Infectivity, Biochemistry, Biophysics, Developmental Biochemistry, Developmental Biology, Endocrinology, Genetics, Immunology, Leprosy & Mycobacterial Research, Microbiology, Molecular Pharmacology, Neurobiology, Neurophysiology & Neuropharmacology, Peptide Chemistry and Virology.

The Institute invites applications from students in their final year in all branches of the physical and biological sciences. In general, approximately ten positions are available each year. For further information and application form please write stating your research interests to: Dr J. B. Ward, Director of Studies, National Institute for Medical Research, The Ridgeway, Mill Hill, London NW7 1AA.

FELLOWSHIPS, GRANTS, SCHOLARSHIPS

UNIVERSITY OF SOUTHAMPTON

Department of Biology

POSTDOCTORAL RESEARCH FELLOW

Applications are invited from biologists with interests in Taxonomy to work with Dr F. A. Bisby and Dr R. J. White for three years commencing March/May 1979. The SRC funded project will involve building a data-base with morphological and chemical legume data and experimenting with the provision of novel taxonomic services for evaluation by a users' panel. The successful applicant will have an interest in the use of computer-based techniques in taxonomic problems.

Starting salary from £3883-£4382 +USS benefits.

Further particulars may be obtained from Mrs E. C. P. Sears, Staffing Section, The University, Highfield, Southampton SO9 5NH to whom applications with curriculum vitae and names of two referees should be sent as soon as possible, and not later than 2 March, 1979. Please quote reference number 1701/R/NSc.

CITY OF LONDON POLYTECHNIC

Sir John Cass School of Science and Technology

RESEARCH FELLOWSHIP

Applications are invited for a research post in the Corrosion and Protection Laboratories of the Department of Metallurgy and Materials to investigate the electrochemical behaviour of anode materials used in power sources based on alkaline electrolytes.

Applicants should preferably have relevant postgraduate experience and hold a higher degree in the field of electrochemistry, chemical metallurgy, or corrosion science. The appointment will be for one year in the first instance, renewable for a second year.

Salary in the range £4221-£4368 per annum.

For further details contact the Secretary, Department of Metallurgy and Materials, City of London Polytechnic, Central House, Whitechapel High Street, London E1 7PF. (Telephone 01-283 1030 Ext 470.)

RESEARCH FELLOWSHIP

Imperial Cancer Research Fund Laboratories, Mill Hill, NW7.

A post-doctoral Fellow

is required to join a group working on the genetic and biochemical analysis of certain heat activated loci in Drosophila melanogaster, using cloned DNA fragments to investigate their organisation and expression. Experience in Molecular biology desirable.

Appointment will be for three years. Salary with entry according to qualifications and experience within range £5332 to £6530.

Further information from Dr D. Ish-Horowicz (01-959 3236).

Applications with curriculum vitae and names of two referees should be sent to the **Secretary, Imperial Cancer Research Fund, Lincoln's Inn Fields, WC2A 3PX** by 24 February 1979.

Research Fellowships

Two post-doctoral Fellowships available for three years in the ICRF Medical Oncology Unit, St Bartholomew's Hospital. Salary range £4882-£6080 + £450 L.W.

1. A cytogeneticist is required to identify chromosomal abnormalities in non-Hodgkin's lymphoma and leukaemia, and to relate these abnormalities to the class of tumour defined by pathological and immunological criteria. Experience of chromosome banding techniques is essential, and a background knowledge of immunology or cytochemistry desirable.

2. An immunologist is required to study the distribution of malignant lymphoma cells and their precursors in lymph node and bone marrow biopsies of patients with lymphoma. Experience in detection of surface antigens, preparation and purification of antisera, or surface phenotyping techniques is considered essential.

Applications with curriculum vitae and 2 referees to **Staff Department, Imperial Cancer Research Fund, Lincoln's Inn Fields WC2.** Closing date 19 March, 1979.

THE UNIVERSITY OF LEEDS

PROCTER DEPARTMENT OF FOOD SCIENCE

Research for School Science Masters

Applications are invited from graduate Science Masters in Schools to take part in research in the Procter Department of Food Science for a period of four weeks in the summer vacation. Two places are available in 1979 and grants to cover expenses incurred are available from the Worshipful Company of Skinners through its Lawrence Atwell's Charity. The research will be of a chemical or physical nature and topics will be selected with subsequent continuation in school laboratories in mind either as part of the school science syllabus or as a research project. The scheme is subject to an age limit of 29. Applications, giving details of career and interests, and the names of two referees, should be sent as soon as possible to the Head of the Department, Procter Department of Food Science, University of Leeds, Leeds LS2 9JT.

UNIVERSITY OF NEWCASTLE UPON TYNE

BOS KALIS WESTMINSTER FELLOWSHIP IN OCEAN ENGINEERING

Applications are invited, from persons who have shown themselves able to carry out original research, for the Bos Kalis Westminster Fellowship in Ocean Engineering tenable in the School of Marine Technology. The Fellowship is financed by the Bos Kalis Westminster Group NV to encourage research into optimal techniques for submarine geotechnical site investigation. Applicants should normally have a higher degree (preferably PhD) in a relevant branch of Science or Engineering.

The Fellowship will be tenable for one year in the first instance from 1 March, 1979 (or such other date as may be arranged). The stipend will be £5129 with membership of the appropriate superannuation scheme.

Further particulars and application forms (which must be returned by 16 February, 1979) may be obtained from the Registrar, University of Newcastle upon Tyne, 6 Kensington Terrace, Newcastle upon Tyne NE1 7RU.

History of Medicine Fellowships

The Wellcome Trust provides grants for research in the history of medicine and maintains Wellcome Units for the History of Medicine in the Universities of London, Oxford and Cambridge, the Wellcome Institute for the History of Medicine in London, and also provides support for a small Unit at Edinburgh University.

Applications are invited for research fellowships of up to three years, to be held in the Wellcome Units or the Wellcome Institute. Applicants must hold a doctoral degree or an equivalent qualification and have a background in history, science or medicine. Applicants should write in the first instance, outlining their research proposals and enclosing their *curriculum vitae*, to the Director of the Unit in which they wish to work. The addresses of the Units are as follows, and letters should arrive **not later than 1st March:**

The Wellcome Institute for the History of Medicine, 183 Euston Road, London NW1 2BP.

Wellcome Unit for the History of Medicine, 47 Banbury Road, Oxford OX2 6PE.

Unit of History of Medicine, University College London, Gower Street, London WC1E 6BT.

Wellcome Unit for the History of Medicine, Free School Lane, Cambridge CB2 3RH.

The Wellcome Lecturer in the History of Medicine, Department of History, University of Edinburgh, William Robertson Building, George Square, Edinburgh EH8 9JY.

If the Director of the academic unit concerned agrees to support the proposal, it will be forwarded to the Wellcome Trust for a decision on whether a fellowship can be awarded. Applicants should write to their first choice only. If unsuccessful, the application may be passed to other Units if the candidate requests it.

THE WELLCOME TRUST

1 Park Square West, London NW1 4LJ.

THE UNIVERSITY OF LEEDS

DEPARTMENT OF ANIMAL PHYSIOLOGY AND NUTRITION

Applications are invited for a temporary post of RESEARCH FELLOW in the above Department for work on a project, supported by the Agricultural Research Council, involving a study of phosphate homeostasis in sheep. Candidates should have a good honours degree in agricultural animal science, veterinary science or physiology and a PhD degree. The appointment will be made for a fixed period of 20 months with effect from 1 April, 1979.

Salary in the range £3883—£5604 on the IA scale for Research and Analogous Staff (£3883—£6555) (under review) according to age, qualifications and experience.

Application forms and further particulars may be obtained from the Registrar, The University, Leeds LS2 9JT, quoting reference number 61/5/E Closing date for applications 23 February, 1979.

UNIVERSITY OF LIVERPOOL

Department of Mechanical Engineering

RESEARCH FELLOW IN FLUID MECHANICS

Applications are invited for the post of Research Fellow in the Department of Mechanical Engineering on a research project to study the Flow of Heavy Plumes in an Atmospheric Environment. The project is funded by the Science Research Council and is tenable for up to three years.

The experimental modelling of the heavy plume will make use of the Department's unique high speed water channel and in consequence preference would be given to an applicant with interest and experience in developing the use of the water channel.

Initial Salary in the range up to £7268 pa subject to age, qualifications and experience of the candidate.

Further particulars and application forms may be obtained from The Registrar, The University, PO Box 147, Liverpool L69 3BX, by whom completed forms must be received not later than 31 March, 1979. Quote Ref. RV/470/NS.

UNIVERSITY OF SOUTHAMPTON

Department of Chemistry

Applications are invited for a

POSTDOCTORAL RESEARCH FELLOWSHIP

in the Department of Chemistry, Southampton University. The person appointed will work with Dr B. Cleaver on a Science Research Council supported project to study the influence of high pressure on miscibility in high temperature liquid systems (molten salts and molten metals), at pressures up to 25kbar and temperatures to 1200°C. The experimental work will be carried out mainly at Southampton, but will also involve use of a new high pressure facility at the National Physical Laboratory, Teddington, for a six month period.

Applicants should hold a PhD degree and should have experience in at least one of the following fields: molten salt chemistry; high pressure technology; thermodynamics of liquid systems. A driving licence would also be an advantage.

The post is available for two years, starting immediately. The starting salary will be in the range £3883-£4382 (under review), depending on age and experience. Applications with curriculum vitae and the names of two referees, should be sent to Dr B. Cleaver, Department of Chemistry, University of Southampton, from whom further particulars can be obtained. Please quote reference number 1608/R/NSc.

UNIVERSITY OF BIRMINGHAM

Department of Physics

RESEARCH FELLOWSHIP 1A

Applications are invited for a postdoctoral Research Fellow to join the Medical Applications group in the Department of Physics, to work on the measurement of fast-neutron spectra in tissue with a view to optimising conditions for fast-neutron therapy. Previous experience with nuclear instrumentation, neutron spectroscopy, and/or computing would be advantageous. This is supported by the MRC.

The post is tenable for three years from 1 March, 1979. Starting salary will be on the appropriate point of the Research Fellow Grade 1A scale, £3883-£6555, plus superannuation. Starting salary will not exceed £4882.

Further particulars are available from the Assistant Registrar, Science and Engineering, University of Birmingham, PO Box 363, Birmingham B15 2TT, to whom applications (three copies) including curriculum vitae and naming three referees should be sent by Monday 19 February, 1979.

Please quote reference NSD2.

BRUNEL UNIVERSITY

School of Materials

COMPOSITES RESEARCH

Applications are invited for the post of SRC Postdoctoral Research Fellow tenable in the Department of Non-Metallic Materials of Brunel University.

The Fellow appointed will be engaged upon a study of metal polyacrylate composites, their structure and properties with the objective of developing new materials.

Applicants should have a PhD or equivalent experience in an appropriate area of materials science or polymer technology. The appointment will be for two years on the IA scale £3910-£4408 plus £450 London Allowance, with FSSU/USS benefits.

Applications including a curriculum vitae and the names and addresses of two referees should be sent to Dr K. A. Hodd, Department of Non-Metallic Materials, School of Materials, Brunel University, Uxbridge, Middlesex UB8 3PH.

RESEARCH FELLOWSHIP

Firemen's Health Research – Monitoring of ECG and other studies

Scientific Advisory Branch
Horseferry House, London, SW1

Senior/Junior Research Fellow

The successful candidate will be appointed to help carry out measurements of heart rate and other physiological functions as part of a work programme investigating stress in firemen's work. The officer will help in planning and developing a study programme for ECG measurement on groups of active firemen and for implementing and maintaining the measurement procedures.

The officer will form part of a small team working on a number of aspects of the health of firemen and will be responsible to a Senior Scientific Officer concerned with the research planning of the team.

The applicants should have an honours degree or equivalent in human physiology with some practical experience in the use of physiological apparatus and the measurement of cardiac and respiratory function. A background in physics and chemistry would be an advantage.

Some travel will be necessary.

The fellowship will be tenable for two years and remuneration will be on the scale £3695-£4580 for Junior Research Fellow and £5092-£6216 for Senior Research Fellow.

Apply in writing by 16th March, 1979 to Miss S. M. Swinborne, Room 203, Whittington House, 19-30 Alfred Place, London WC1E 7EA.

Home Office

PhD in Business Studies

The London Business School accepts about 10 mature students each year for full-time doctoral study in the field of management. They work closely with faculty in the School's main research programmes. Students now on the programme came with first degrees in e.g. economics, psychology, engineering, mathematics; some have MBA degrees or research experience in other fields. SSRC funding is available for suitably qualified UK students. Applications are invited for entry to the programme starting in October 1979.

For fuller details please write to

Prof David Chambers,
London Business School,
Sussex Place, Regents Park,
London NW1 4SA.

BRUNEL UNIVERSITY

School of Chemistry

RESEARCH FELLOW IB IN ORGANIC CHEMISTRY

Applications are invited from graduates or equivalent for the post of Research Fellow IB supported by the Cancer Research Campaign until 31 March, 1981, in the first instance. The person appointed will work with Drs Parrick and Wallace on aspects of synthetic heterocyclic chemistry and will collaborate with workers at the Gray Laboratory, Mount Vernon Hospital, Northwood. The initial salary will be £3860 pa (including London weighting) with annual increments. The appointee may be able to register for a part-time higher degree. Informal enquiries are welcome (ring Uxbridge 37188, extn. 184).

Further details and application forms may be obtained from Dr J. Parrick, School of Chemistry, Brunel University, Uxbridge, Middlesex UB8 3PH. It is intended to make an appointment as soon as possible.

Closing date for applications, 26 February, 1979.

UNIVERSITY OF LEICESTER

PHYSICS RESEARCH PhD

The Department of Physics offers excellent research opportunities leading to the degree of Doctor of Philosophy in the following areas:

IONOSPHERIC PHYSICS
NUCLEAR ELECTRONICS
QUANTUM MOLECULAR PHYSICS
SOFT X-RAY SPECTROSCOPY
SOLID STATE PHYSICS
THEORETICAL PHYSICS
X-RAY ASTRONOMY

Further details and application forms may be obtained from Professor J. L. Beeby, Department of Physics, University of Leicester, Leicester LEI 7RH.

UNIVERSITY OF DURHAM

Department of Geography

RESEARCH FELLOW OR RESEARCH ASSISTANT

Applications are invited for the above post tenable for up to eighteen months to work with Dr D. Rhind on a feasibility study of the needs of academics from the next Census of Population and on related issues. Experience in the analysis of census data, or the distribution of computerised data would be an advantage.

Salary in the range £3883-£5842 pa (Research Fellow) or £3384-£4882 pa (Research Assistant) plus superannuation.

Applications (3 copies) naming three referees and the post sought should be sent by 28 February, 1979, to the Registrar and Secretary, Science Laboratories, South Road, Durham DH1 3LE, from whom further particulars may be obtained.

KEBLE COLLEGE, OXFORD

The College is offering

THREE SENIOR SCHOLARSHIPS

open to women and men in any subject tenable from 1 October, 1979, for up to three years. With one of the Scholarships preference is for someone not graduating until summer 1979. The value is £150 per year, with limited dining rights at High Table and preference in allocation of accommodation.

Further particulars and application forms may be obtained from the Secretary to the Tutor for Graduates; closing date for applications is 14 March.

LANCHESTER POLYTECHNIC

Coventry

Department of Biological Sciences

Post Doctoral Research Fellowship

(Tenable for up to 3 years from 1 March, 1979)
£4101—£6558

THE JOB:—The project is funded jointly by the SRC and ICI and involves the development of a method for the in vitro culture of perifused hepatocytes supported in a 3-dimensional matrix and its application to toxicological studies.

REQUIRED:—Experience in animal cell culture and biochemistry. Knowledge of cytological procedures would be an advantage.

For further information applicants may contact Dr Sturdee or Dr Crisp by telephoning Coventry (0203) 24166.

Faculty of Applied Science

Research Assistant in Cardiac Pacing

(Tenable for 1 year from 1 March, 1979)
£3192—£3330

THE JOB:—A statistical survey of patients with artificial cardiac pacemakers is required to attempt to identify those factors which cause a rise of stimulation threshold in certain patients. The required collection of data will involve close collaboration with cardiac pacing centres in a number of hospitals.

REQUIRED:—Applicants should have either an appropriate Honours Degree, or an appropriate HNC plus relevant experience.

For further information applicants may contact Dr Economides or Dr Duckers by telephoning Coventry (0203) 24166.

For application forms and further particulars for the above posts, please apply in writing enclosing a foolscap stamped and addressed envelope to the Personnel Officer, Lanchester Polytechnic, Priory Street, Coventry CV1 5FB, applications returnable by 19 February, 1979.

DEPARTMENT OF MATERIALS

POLYMER ENGINEERING SENIOR FELLOWSHIP

Applications are invited for the post of Principal Research Officer/Teaching Fellow in the field of Polymer Engineering.

The person appointed will be expected to play a major role in the expanding Polymer Group of the Department which has wide interests all involving industrially supported work in processing, fabrication, engineering properties and design in polymeric materials.

Applicants should have substantial relevant experience and the motivation and ability to develop further close industrial contacts in the R&D field through joint projects. The successful applicant will also be required to play a major part in the further development of special postgraduate courses and short courses in polymer engineering, with particular *emphasis on fabrication and processing*.

Salary will be in the range £7506 to £9885 (currently subject to revision). Superannuation on USS.

CRANFIELD INSTITUTE OF TECHNOLOGY
ADVANCED TEACHING + APPLIED RESEARCH

For further information contact
Mrs J. E. Grey
Departmental Secretary
Materials Department
Cranfield Institute of Technology
Cranfield
Bedford MK43 0AL
Tel: 0234 750111 Ext. 324

WEST MIDLANDS REGIONAL HEALTH AUTHORITY
Blood Transfusion Service
RESEARCH FELLOW IN CRYOBIOLOGY

A vacancy exists for a Scientific Officer in the laboratories in Birmingham. Applicants should be graduates in Biological sciences, Biochemistry or another appropriate science. The position involves working as part of a combined Transfusion Service and University Team investigating aspects of human bone marrow preservation, culture and infusion. Salary scale in the range £3486 to £3798 depending upon experience. The fellowship has a tenure of three years. Applications in writing to the Director, Blood Transfusion Service, Vincent Drive, Edgbaston, Birmingham B15 2SG.

FOR SALE

For Sale

RCA Electron Microscope Model EMU4

Magnification range 1700-200 000 times.

It is fitted with a high intensity plug in system film or plate. 18 Exposure Cassettes. This equipment is in excellent working order, and has been maintained under a service contract with the manufacturers.

Price ex site £3000.

Phone Brighton 723242.

BOOKS AND PUBLICATIONS

'THE MICROELECTRONICS REVOLUTION

A Brief Assessment of the Industrial Impact with a Selected Bibliography.' 87 pages, A4, 255 refs, cost £3·00 (incl. p&p). Produced by the Technology Policy Unit, University of Aston, Gosta Green, Birmingham B4 7ET. Cash with order please.

HOLIDAYS

NEAR LOCH NESS

Self-catering cottage, sleeps four-five. Also flat, sleeps three. Tel: Gorthleck 200.

PERSONAL

RAPPORT

is the intelligent person's introduction service. Whatever your age, location or preferences, enrich your quality of life immeasurably with RAPPORT—and rediscover the joy of living. Special introductory rates this month for readers of this magazine. SAE for details to RAPPORT, P.O. Box 94, Oxford.

WRITERS

with experience in journalism or other popular media required by London publishers for a series of paperback books. Please telephone 01-606 9373.

FUNDING REQUIRED

for 6 months' freedom to write a textbook. All assistance acknowledged. Box number D359.

---

new scientist
The international news weekly of science & technology

MICROFILM EDITION:
Fiche or 35mm Roll Film including Indexes and backruns. Enquiries to Oxford Microform Publications, Wheatsheaf Yard, Blue Boar Street, Oxford OX1 4EY.

INDEXES:
Published quarterly six weeks after the end of each quarter. Indexes are included with all subscription copies and do not need to be ordered separately. Back numbers (60p per index) subject to availability for the past five years from 2614 King's Reach Tower, Stamford Street, London SE1 9LS. Payment with order. Cheques made payable to New Scientist.

BINDERS:
To hold 13 copies (one quarterly volume) £2·70 from Easibind Limited, 4 Uxbridge Street, London W8 7SZ. Overseas 25p extra. Payment with order. Cheque made payable to Easibind.

BACK NUMBERS:
60p per copy including postage from, Post Sales Dept. IPC Magazines Limited, Lavington House, Lavington Street, London SE1 0PF. Payment with order. Cheques made payable to New Scientist.

ANNUAL SUBSCRIPTION RATES

U.K., Isle of Man, Channel Islands and Irish Republic	£20.70
(Students	£18.60)
U.S.A. & Canada (Air Freight)	$54.00
(Students	$50.40)
Other Overseas (Surface)	£22.90
(Students	£21.10)
Air Mail (Except USA & Canada)	£40.90

SUBSCRIPTION ORDERS:
Should be sent, with payment to 1st Floor Post Room, Oakfield House, Perrymount Road, Haywards Heath, Sussex, RH16 3DH, England.
Cheques made payable to New Scientist

SUBSCRIPTION ORDER FORM
Please send me New Scientist each week for one year. I enclose payment of £ ____________
Name: ____________
Please Print Address: ____________

New Scientist is printed in Great Britain by Index Printers, Oldhill, London Road, Dunstable, Beds, and Metro/Thomas Jenkins (Printers) Ltd, 89–91 Norwood Road, London SE24 and published by IPC Magazines Ltd, King's Reach Tower, Stamford Street, London SE1 9LS. Sole Agents for Australia and New Zealand, Gordon & Gotch (A'sia) Ltd. For South Africa: Central News Agency Ltd. Conditions of sale: this periodical shall not, without the written consent of the publishers first given, be lent, resold, hired out or otherwise disposed of by way of trade at more than the recommended selling price shown on the cover (selling price in Eire subject to VAT) and it shall not be lent, resold or hired out or otherwise disposed of in a mutilated condition or in any unauthorised cover by way of trade or annexed to or as part of any publication or advertising, literary or pictorial matter whatsoever.

Ariadne

■ Stop London Transport at once! If necessary, lie down in front of its buses to prevent egress. Bombard its offices with letters of protest. We have more than enough noise in the world already. London Transport has appalling plans to make things worse.

It plots, in April, to run what it terms shop-linking buses, connecting Oxford Street, Knightsbridge and Kensington. A good idea, I thought, until I found, eyes starting out of my head, that the buses would be flooded with soft music and commercials. We all know what that means. Utterly bland musical pap will flow like arrowroot, smothering thought and any other process that can be called mental. That's when the subtle commands to buy this or that special offer will slither into the ears. It wouldn't surprise me if London Transport has plans to pipe insidious scent to each seat as well.

God knows in these days of idiots walking about with radios playing, Muzak even in lifts and gratuitous rubbish blasting out of railway station loudspeakers, music has been degraded sufficiently. London Transport's plan is contemptible because it is contemptuous of the most noble of the arts and of passengers alike. It will probably get a congratulatory write-up in *Campaign*.

It is also likely to be the thin end of a specially horrendous wedge, for, as far as I can see, London Transport is ignoring its own bye-laws forbidding the playing of musical instruments on its vehicles, including radios and tape recorders. British Rail was only just stopped from issuing audio-Farex by the Imperial quart to helpless passengers on inter-city trains. It may be encouraged to try again.

■ For someone who certainly was as impressed as I by scientists at one time, attending a lecture at the Royal Society can be a startling experience. That's the general; now for the particular. I was among the audience for Professor Longuet-Higgin's talk recently on the perception of music. He began by carefully explaining that he was about to talk only on Western classical music, the only kind of music at which he thought himself competent.

Going on to play examples on an organ, pointing out that the octave was divided into 12 parts and explaining how the brain will quickly change its pattern of reference to accept a C sharp as a D flat, Professor Longuet-Higgins finally broke into a computer program for noting music.. (I got it wrong. When he showed an example I worked it out as "Baa, baa, black sheep". It was Wagner).

There was, of course, a time for questions at the end. When the customary shifty glances had been given and feet shuffled, the questions came. They were nearly all quite outside the subject of the lecture. Some were distinctly waspish. What right had Professor Longuet-Higgins to say what he did about the octave when it was well-known that African and Eastern musicians divided it into far smaller intervals? What was the lecturer's explanation for our apparent necessity for music? "I don't know," said he.

At the very least, I had considered that scientists could stick to the point. Even if the questioners weren't scientists then I would have expected a Royal Society audience to be germane, I thought, carrying disillusion into the snow outside.

■ For years you can treasure and use a quotation without stopping to think about it. Recently, I have discovered that I don't really understand what Oscar Wilde said about cynics, which was, "A cynic is a man who knows the price of everything and the value of nothing." It comes from *Lady Windermere's Fan*.

On the other hand, it's not difficult to recognise cynicism without the aid of Wilde. I am old enough to be disturbed by naked political cynicism and to be even more so when it passes unnoticed, even by a glance. It concerns the mooted price freeze Bill, which would put a stopper on increases for such things as food, gas, petrol and beer. A Scottish National MP (unnamed) was asked about his voting intentions. He replied, "It would be madness for us to vote for dearer petrol and beer just before the election, whatever the economic rights and wrongs of the Bill." Of course, by Wilde's definition, a cynic should be well up on prices.

■ In its steady renewal, our skin is always shedding its outer layers. This steady loss of dead cells, many grams a day, passes unnoticed except for that fraction which accumulates as grime on our clothes; but my sartorphytal friend Daedalus reckons it can be usefully reclaimed. He is experimenting with a flannel shirt sown with mustard-and-cress. It will take up both sweat and skin-detritus as a sort of animal fertiliser. Thus the wearer is automatically kept clean, and his losses are recycled to help growth of his garment. Cress looks pretty but is not an ideal skin-scavenger. Daedalus has hopes of lichens (symbiotic fungus and algae), legumes (with their symbiotic root-bacteria), etc. The aim is a vegetable culture which, seeded onto an open-weave garment, will grow into a dense, insulating, wear-resistant mat. Outside it will be leafy or mossy, while on the inside a soft and absorbent root-structure glides over and constantly cleanses the wearer's skin during his body-movements. His clothing will actually thicken and grow stronger with age! And neither will ever need washing. Cunning enough biology may even produce a logical hierarchy of garments, each feeding on the one beneath, and with a decorative flowering outer jacket, say, at the top of the food-chain. But too rampant a sartorial eco-structure might attract butterflies, bees, blackbirds etc, and might take to scavenging the wearer's skin before he had really finished with it. A more modest ideal would be safer, with slow-growing microflora seeded in pleasing patterns which would slowly change and spread. Such clothes would solve the fundamental overstocked-wardrobe dilemma, too. For while regularly worn they would last for ever, even growing to adapt to e.g. middle-age spread. But a neglected garment, left in the back of the wardrobe as unfashionable, would wither and die—leaving the wearer no choice but to recycle it by boiling into nutritious soup.

OK, I demonstrate the sunshine roof, eh, guys?

It's as if every day is November 5th

"Rolls-Royce" it has been said (Engineering Today, November 1978) "is the company that proves engineering is exciting".

Excitement of course is something you can't measure on a slide rule, but you can sense it as you home in on a company's R & D.

At Rolls-Royce, technologies are being stretched to yield new truths about materials and methods . . .

That's exciting.

Every day, fundamental problems to do with heat and its dissipation, engine thrust and fuel efficiency, there are very many others, are being exposed, explored and brought nearer to a solution . . . And that's exciting too.

After which another kind of excitement happens, when Rolls-Royce turbines are chosen again for aircraft, hovercraft, ships, oil rigs, power stations. And Rolls-Royce technology spins off into nuclear submarines and electrical generation as well.

The result is an order book that takes Rolls-Royce into the 1990s, and ideas now on the drawing board that will excite the 21st century.

A future that's as near certain as can be . . . What can be more exciting than that these days?

Rolls-Royce Limited,
65 Buckingham Gate, London SW1.

ROLLS RR ROYCE

ROLLS-ROYCE LIMITED

Come with us into the 21st century

Our coverage is universal. Our readership is international.

Simply fill in the form below and we'll get New Scientist to you wherever you are.

To New Scientist, Subscription Department, Ground Floor Post Room, Oakfield House, Perrymount Road, Hayward's Heath, Sussex RH16 3DH, England.

Tick the appropriate box. Copies will be sent to you each week by post. Please send payment with order, by cheque or postal order made payable to New Scientist.

	1 Year	*6 Months*
U.K. Isle of Man, Channel Islands and Irish Republic	☐ £20.70	☐ £10.35
Student	☐ £18.60	
U.S.A., Canada	☐ $54.00	☐ $27.00
Student	☐ $48.50	
Overseas—Surface mail	☐ £22.90	☐ £11.45
Airmail	☐ £40.90	☐ £20.45
Student	☐ £21.10	

Name______________________________
(Block letters please)

Address______________________________

____

newscientist

IPC Magazines Ltd., Company registered in England. Regd. No. 53626. Registered Office: King's Reach Tower, Stamford Street, London SE1 9LS.